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Economic Impact Analysis of Proposed Effluent Guidelines and Standards for the Electrical and Electronic Components Industry. Phase 2 Cathode Ray and Luminescent Coatings Subcategori

Meta Systems, Inc.
Cambridge, MA

Prepared for

Environmental Protection Agency
Washington, DC

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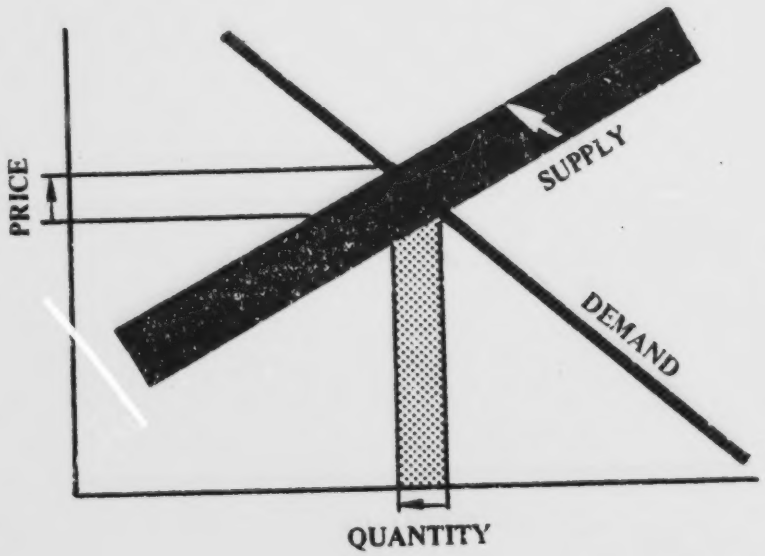
Phase II- Cathode Ray and Luminescent Coatings Subcategories



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Economic Impact Analysis of the Electrical and Electronics Components Industry

Economic Analysis of Phase II Electronics

by:

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Section 1

Executive Summary

I. Introduction

This study is concerned with two industry subcategories that are part of the electrical and electronic component industry. The two are cathode ray tubes and luminescent coatings. Cathode ray tubes (CRT's) are used in a variety of equipment such as television receivers, scientific instruments, oscilloscopes, computers, industrial controls and military hardware.* Luminescent coatings are used in the manufacture of all types of CRT's and also in the manufacture of fluorescent lamps, mercury lamps, lasers, instrument panels, postage stamps, laundry whiteners and speciality paints.

Several wastewater treatment alternatives were developed for the two industry subcategories in response to federal legislation. The 1972 Federal Water Pollution Control Act (and subsequent litigation) and the Clean Water Act of 1977, require EPA to develop a program and adhere to a schedule in promulgating effluent limitations guidelines, new source performance standards and pretreatment standards for 65 groups of "priority" pollutants for 21 major industries. This study presents for consideration, the projected economic impacts of complying with proposed regulations as required by the Clean Water Act.

II. Industry Profile

Color TV picture tubes and other CRT's are but two of a large number of products associated with the electronics industry which include electronic components, consumer, industrial and military electronics, communications equipment and systems. Overall factory sales of electronic systems and components were $114 billion in 1981 of which $24.4 billion (21.4%) was electronic components that include solid state devices ($7.8 billion) passive components such as resistors and capacitors ($2.9 billion) and electron tubes. Sales of electron tubes of all types amounted to $2.0 billion of which approximately $1.0 billion was in power and special purpose tubes (which include CRT's other than color TV picture tubes).

In the Standard Industrial Classification (SIC) system, electron tubes of all types are classified within SIC 3671. Luminescent coatings are not classified as part of the electronics industry but fall primarily within SIC 2819, a large group of miscellaneous industrial inorganic chemicals, not elsewhere classified.

Over the past decade, 1971-1981, the value of U.S. production of color TV picture tubes increased at an average annual rate of 1.2 percent in real terms. According to industry forecasts, the outlook is that annual sales of color TV picture tubes will increase at a rate averaging 6.9 percent

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* The cathode ray tube subcategory is subdivided into two industry segments--color TV picture tubes and other CRT's--for purposes of the impact analysis.

annually, in current dollars; in real terms, this should result in 1985 sales of $1.05 to $1.09 billion (expressed in 1981 dollars, based on an average annual rate of inflation of five to six percent).

For other CRT's, the value of production grew at an average annual rate of eight percent between 1972 and 1981 in real terms. Industrial and military type CRT sales amounted to $118 million in 1981, equivalent to 35 percent of all sales of electro-optical products; military and industrial portions cannot be separately identified in the available information. In 1985, the value of sales is expected to be 15 to 19 percent greater than in 1981, expressed in constant 1981 dollars; this will result from an average annual rate of real growth of 3.5 to 4.5 percent.

Employment in the electron tube industry overall (SIC 3671) increased only slightly (0.05 percent annually) over the past decade; in 1981 total employment was 43,500 and of these 60 percent were production workers. In the current decade, 1980 to 1990, Bureau of Labor Statistics indicate rising employment, at a rate of 1.7 to 2.5 per year.

Prices of color TV picture tubes in 1980 averaged $90 (all sizes) for U.S.-made tubes compared to $56 for imports, most all of which come from Japan; differences in average prices were due in part to the fact that U.S.-made picture tubes account for a greater share of the large screen sizes. For other CRT's, industrial and military types averaged $197 per tube in 1980.

Foreign trade in color TV picture tubes is linked to foreign trade in television receivers. Imported tubes have been increasing over the last five years and in 1981 the number of tubes increased by 67 percent over 1980. The U.S. Tariff Act of 1980 invoked anti-dumping measures for Japanese-made TV sets. Whether or not the anti-dumping measure for imported sets will be relaxed, or continued, is currently under evaluation by the U.S. government. This decision, as well as other potential import limiting measures for electronic products, could affect the growth of U.S. production of color TV picture tubes. The value of imports of other CRT's has also been growing. In 1981 imports accounted for an estimated 24 percent of U.S. sales of other CRT's. Balance of trade has been positive for color TV picture tubes with CRT's and for electron tubes of all types. However, for picture tubes, the balance has declined from $60 million in 1977 to $49 million 1980 and to $12 million in 1981; for other CRT's the balance has increased from $11.6 million to $37.9 million in 1981.

Five firms are known to manufacture color TV picture tubes in the U.S., not including those who recondition used tubes; the firms are RCA, Zenith, General Electric, North American Philips and Sony. An estimated 13 to 15 companies produce CRT's other than TV picture tubes, including two of the largest (Tektronix and Hewlett Packard) who use much of their CRT production captively. Five firms are known to manufacture luminescent coatings; RCA, General Electric, Westinghouse, GTE-Philips and U.S. Radium Company.

III. Economic Impact Methodology

The methodology consists of seven steps which address the following points: (1) baseline estimates for the three industry segments, (2) measures of treatment cost impacts at the industry, plant and firm level, (3) potential plant closures, (4) production and employment effects, (5) foreign trade implications, (6) new sources and (7) implications for small businesses.

III.1 Baseline Estimates and Measures of Impact

Impacts at the industry level, as well as at the firm and plant level, result from treatment costs incurred by the plants. Estimates of value and quantity of production and profit--without additional treatment costs--serve as a baseline against which the impacts of treatment costs are estimated. The baseline estimates are made for 1982 because treatment costs were estimated in 1982 dollars. Different methods are used to estimate industry-wide baseline values for each industry segment (color TV picture tubes, other CRT's and luminescent coatings) because available data are different with regard to (1) time periods for which data are reported and (2) level of data aggregation for the different segments.

Industry-wide impacts for each subcategory are considered for two cases. In one case, the analysis assumes manufacturers pass through the additional costs for treatment; thus prices (and value of production) rise which can affect demand and, in turn production and employment. In the second case, the analysis assumes that additional costs are absorbed by manufacturers, thus baseline prices are unchanged but profits decline.

Three of the financial ratios reported in Dun and Bradstreet are used to judge the financial health of firms whose plants incur additional treatment costs. The ratios which are examined for both the baseline and impact projections are: current assets to current liabilities, sales to net working capital, and return on assets.

Five plant-level impact measures are used in the analysis. Four of these are ratios of annual treatment costs relative to (1) plant sales, (2) plant manufacturing cost, (3) plant-level profit, and (4) firm-level profit. The fifth is a ratio of the capital investment portion of treatment cost to yearly plant investment. Plant sales are obtained from the EIS (Economic Information Systems) data file. Firm-level profit for publicly-owned companies is obtained from Form 10-K reports and Moodys Industrial Manual. The denominators of the other three ratios are estimated from a set of derived factors, multiplied by 1982 plant sales. The factors are average 1977 values of manufacturing cost per dollar of sales, plant-level profit per dollar of sales, and annual capital investment per dollar of sales; sales and value of shipments are assumed to be synonymous. The factors are calculated from the 1977 Census of Manufacturers at the four-digit SIC level of aggregation that is most appropriate for each industry subcategory. For

example, a 1982 estimate of the manufacturing cost for a color TV picture tube plant is estimated as the 1982 plant sales multiplied by the manufacturing cost-to-sales ratio in 1977 computed for SIC 3671--electron tubes, all types. This approach treats each plant as if it operated with the same ratio of manufacturing cost-to-sales and plant profit to sales and capital investment to sales as described by the average for the four-digit SIC group. The approach was employed because, other than sales, no financial information is available for individual plants.

III.2 Possible Plant Closures

Judgments are made about the possibility of plant closure based on the magnitude of impact ratios, the financial conditions of the parent company and other characteristics such as vertical integration within a firm.

III.3 Production, Employment and Foreign Trade

Judgements are made about price impacts if cost of treatment is passed through, and take into account that cathode ray tubes and luminescent coatings are only part of the price of end-products in which they are used.

Employment effects are derived from production changes based on the value of production per worker. Judgements about foreign trade are also based on the magnitude of potential price changes from the pass through of treatment costs.

III.4 New Sources

Impacts on new sources are calculated based on incremental cost for a higher level of required treatment for new plants compared to existing plants for direct and indirect sources. Three sizes of model plants are postulated for estimating treatment costs and production estimates are approximated based on existing plants. Judgements are made about the additional cost for new sources posing an economic disadvantage to entry into the three industry segments.

III.5 Small Business Analysis

Under the Regulatory Flexibility Act of 1980, the EPA must consider the effects of proposed regulations on small businesses. The distribution of treatment costs incurred by different size firms is estimated to identify the potential impacts on those firms considered to be small businesses.

IV. Effluent Limintations Guidelines Options and Costs

Under the Clean Water Act of 1977, the EPA program is to set a number of different kinds of effluent limitations and standards designated as follows:

- o Best Practicable Control Technology Currently Available (BPT);
- o Best Available Technology Economically Achievable (BAT);
- o Best Conventional Pollution Control Technology (BCT);
- o New Source Performance Standards (NSPS);
- o Pretreatment Standards for Existing Sources (PSES) and for New Sources (PSNS).

EPA estimated a total of 27 plants are covered by the proposed regulation. Treatment technologies appropriate for CRT's and luminescent coatings are developed in the Proposed Development Document.

IV.1 Treatment Options

For cathode ray tube plants, three treatment technologies considered are:

Option 1: No required treatment, specific conditions are met that allow exclusion of regulatory requirements.

Option 2: Solvent management to control total toxic organics, chromium reduction with the use of sulfuric acid and sodium bisulfite, chemical precipitation and classification of all metals--bearing process wastes, sludge de-watering and pH adjustment.

Option 3: Option 2 plus multimedia filtration.

For luminescent coatings plants, there are two options:

Option 1: No required treatment.

Option 2: Chemical precipitation and clarification of all metals-bearing process wastes using lime, a coagulant and a polyelectrolyte, sludge de-watering and pH adjustment.

The treatment options are applied to each regulation and the specific designations are shown in Table 1-1.

Table 1-1. Treatment Option by Regulation and Type of Discharger

Option	Existing Direct*	Existing Indirect	New Source Direct	New Source Indirect
1	BPT/BAT-1	PSES-1	NSPS-1	PSNS-1
2	BPT/BAT-2	PSES-2	NSPS-2	PSNS-2
3**	BPT/BAT-3	PSES-3	NSPS-3	PSNS-3

* BPT, BCT, and BAT all apply to existing direct dischargers.

** Applies only to the CRT subcategory.

IV.2 Treatment Costs for Existing Plants

In estimating treatment costs, Option 1 would require no additional treatment of wastewater effluents. For existing sources, model plant treatment technology is developed and costed; the estimates are applied to existing plants by making adjustments to account for actual flow size and treatment currently in place.

Table 1-2 summarizes the cost information for the plants included in the study. Of the total plants, only three are direct dischargers. Sixteen are indirect dischargers. Five small CRT plants use contract hauling and are considered zero dischargers. The treatment costs for the two major industry subcategories are summarized by direct and indirect dischargers and by option. Option 3 does not apply to the coatings subcategory.

Table 1-2. Summary Table for Existing Sources

	Number of Plants by Industry Subcategory			
	Luminescent Coatings Plants		CRT Plants	
	Direct	Indirect	Direct	Indirect
Total Number of Plants*	2	2	1	14
Incurring Costs at:				
Option 1	0	0	0	0
Option 2	2	2	1	14
Option 3	N.A.	N.A.	1	14
Treatments Costs ($000)**				
Option 1				
Capital Costs	0	0	0	0
Total Annual Cost	0	0	0	0
Option 2				
Capital cost	5.00	98.40	2.50	9,945.60
Total Annual Cost	27.40	84.90	13.70	2,743.80
Option 3				
Capital Cost	N.A.	N.A.	2.50	5,648.50
Annual Cost	N.A.	N.A.	13.70	3,042.25

Notes:

N.A. = Not applicable.

* For Luminescent Coatings, there is one zero discharging facility. For CRT plants, five facilities with small flows currently haul their wastewater flow and are considered zero dischargers for this analysis. There are two CRT plants for which information on current treatment is not available; one of these plants will be relocated in the near future.

** Dollars are 1982 $.

IV.3 Treatment Costs for New Sources

Treatment costs for new sources are summarized in Table 1-3 for three model plant sizes. The costs shown are incremental with respect to raw waste load treatment technology. The model plant costs for direct discharges (NSPS) and indirect dischargers (PSNS) are the same.

IV.4 Selected Options

The EPA has selected the options (summarized in Table 1-4) for the proposed regulations. For existing CRT plants, that selection is Option 2. For new CRT sources, Option 3 is selected. For new coatings plants, Option 2 is selected.

Table 1-3. Treatment Costs by Option for New Sources (NSPS and PSNS)

Subcategory	Model Plant Flow Size (gpd)	Total Annual Costs ($000) Option 2	Option 3
Luminescent Coatings	10,000	68.2	70.3
	100,000	328.5	336.4
	250,000	589.6	628.0
CRT's	10,000	75.5	77.6
	100,000	392.1	410.0
	500,000	836.7	905.2

Table 1-4. Selected Options for Proposed Rules

	Luminescent Coatings Plants	CRT Plants
Existing Sources		
BPT/BCT/BAT	BPT/BAT-1	BPT/BAT-1
PSES	PSES-1	PSES-2
New Sources		
NSPS	NSPS-2	NSPS-3
PSNS	PSNS-2	PSNS-3

V. Results of the Analysis

V.1 Baseline Estimates

At the industry level, the 1982 baseline estimates are shown in Table 1-5 for the three industry segments.

At the firm level, the financial health of ten publicly-owned companies whose plants may incur treatment costs were judged by the three financial ratios. (Seven other firms are not publicly-owned and therefore the necessary data are not available.) Several firms have relatively low solvency rating (current assets to current liabilities) but no marked weakness in the other two ratios (net sales to net working capital and return in total assets). Return on assets has been low for several years for all but one of the firms, but none of the firms are judged to be in serious financial difficulty.

V.2 Impact Estimates: Industry-Wide

At the industry level, two cases are considered; i.e., treatment costs are assumed to be fully absorbed by manufacturers or costs are assumed passed through resulting in higher prices. The results are summarized in Table 1-6 which shows that for the higher treatment level, Option 3, if costs are fully absorbed, estimated baseline profit decreases no more than 1.42 percent (which occurs in the industry segment other CRT). If costs are passed through, price rises are expected to be no more than 0.65 of a percent.

V.3 Impact Estimates: Firm Level

At the firm level, treatment cost impacts on the financial health of publicly owned companies are imperceptible. For example, RCA has three plants that incur cost under Option 3, however, the total annual cost of $973 thousand has no significant effect on the financial ratios, given that total assets of the firm are $7.8 billion.

V.4 Impact Estimates: Plant Level

Color TV Picture Tubes. Seven existing plants would incur costs under selected Option 2, and would incur costs under Option 3. Except for one plant (Zenith, Melrose Park, Illinois, which is closing according to a recent announcement), all the impacts based on annual costs are small, less than two percent; these impacts are annual treatment cost to: a) sales, b) manufacturing cost, c) plant level plant profit, and d) firm's net income. The capital investment portion of treatment cost is less than 21 percent of annual plant investment for Option 3, excluding the Zenith plant.

Table 1-5. 1982 Baseline Estimates

	Color TV Picture Tubes	Other CRT's	Luminescent Coatings
Production Quantity (million units)	11.5	0.52	NA
Value of Production (Millions $)	1048.60	137.44	345.0
Unit value ($ per CRT)	91.18	264.30	NA
Industry Profit (million $)	364.90	63.00	132.13

NA = Not available; dollars are 1982 $.

Table 1-6. 1982 Industry-Wide Impacts

Industry Segment	1982 Baseline (Millions $)	1982 Impacts (Percent*) Option 2 Costs Absorbed	Option 2 Costs Passed Through	Option 3 Costs Absorbed	Option 3 Costs Passed Through
Color TV Picture Tubes					
Value of Production	1,048.60	0	+.18%	0	+.21%
Industry Profit	364.90	-.52%	0	-.60%	0
Other CRT					
Value of Production	137.44	0	+.54	0	+.65%
Industry Profit	63.00	-1.37%	0	-1.42%	0
Luminescent Coatings					
Value of Production	345.00	0	+.02%	N.A.	N.A.
Industry Profit	132.13	-.08%	0	N.A.	N.A.

* Percent change from Baseline Estimate.

Other CRTs. Eight of the 15 plants incur treatment costs under selected Option 2 and also under Option 3 (for two plants no treatment costs were estimated). Except for two relatively small plants, all impacts are small. These two, plus another CRT plant are owned by one firm, Thomas Electronics. Their most impacted plant, (in Los Angeles) shows an annual treatment cost-to-sales ratio of about just under four percent for either Option 2 or 3; the ratio of treatment cost to manufacturing cost is 6.00 percent, and for treatment cost to plant profit it is 8.18 percent for Option 3. The capital cost for treatment is 1.29 to 1.37 times as great as the annual plant investment for Option 2 and Option 3, respectively.

Luminescent Coatings. Four of the five existing plants would incur a cost under Option 2. All of the impact measures are small, less than two percent. Under the selected Option 1, no treatment costs are incurred.

V.5 Possible Plant Closures

Color TV Picture Tube Plants. There are no plant closures anticipated as a result of treatment costs. It should be noted that plant-level impacts are expressed with reference to plant sales. However, a plant may have multiple product lines, and if so, treatment costs should be allocated only to those lines which incur the costs. Thus, the impacts could be more severe than have been calculated, however, sales data on a product line basis are not available for TV picture tube plants (or for plants in the other two industry subcategories).

Other CRT Plants. Two plants owned by Thomas Electronics (in Los Angeles and Clyde, NY) show the highest values of impacts. The Los Angeles plant (with sales of $1.7 million) and the Clyde, NY plant ($2.4 million sales) are small relative to a third plant in Wayne, NJ (with $9.2 million sales). Financial data for this privately-owned company are not available. However, estimates of company sales ($400 million) and employment (400 workers) suggest adequate capital availability to finance the necessary capital investments ($79.0 thousand for Option 2 and $84.2 thousand for Option 3 for each of the three plants). Therefore no plant closures are anticipated.

Luminescent Coatings. None of the plants are considered as closure candidates because no regulation is being written for existing plants.

V.6 Production and Employment Impacts

If treatment costs are fully absorbed, prices of plant outputs are unchanged and therefore no changes in demand or production are projected. If costs are passed through, they are unlikely to affect demand because: 1) treatment costs relative to value of production is less than one percent, except for the Thomas Electronics plants, and 2) price changes for components such as CRTs or coatings are greater than price changes that would be

induced in end-products in which the components are used. Though not anticipated, if one of the small Thomas Electronics plants closed, the geographical distribution of production might change slightly, but there is no basis to suggest the industry-wide production would decline. Employment levels are not projected to be affected by the treatment costs.

V.7 Foreign Trade

The costs for any of the treatment options are not likely to result in impacts on foreign trade due to price changes of products or to the sourcing locations by manufacturing firms. As noted before, price effects of treatment costs, if passed through, are small. The decision to relocate U.S. plants in foreign countries (or for foreign firms to produce in the U.S.) are based on more fundamental economic and political considerations than can be associated with the relatively small treatment costs.

V.8 New Sources

More stringent wastewater treatment requirements for new sources compared to existing plants could result in additional costs sufficient to act as a barrier to new firms entering the industry or to existing manufacturing firms who might build new plants. Whether or not current capacity can handle increased demands is not considered here because no information is available on current plant capacity and utilization for any of the three industry segments.

For the CRT subcategory, the additional treatment cost for new plants is the incremental cost between Option 3 and Option 2 because all existing indirect dischargers will comply with PSES-2. (Only one of the 22 plants in the CRT subcategory is a direct discharger and currently complies with BAT-3.) For new luminescent coatings plants, the additional treatment cost is the total cost for Option 2 because no regulation is proposed for the existing plants.

New CRT Plants. Two cases are analyzed in comparing new CRT plants with existing plants. Two cases are considered because regulations are proposed for existing indirect CRT dischargers but not for direct dischargers. Case A analyzes the incremental treatment costs between Option 3 and Option 2 (both color TV picture tubes and other CRT's). Treatment costs estimated per CRT range from $0.02 to $.63 which is less than one percent of the baseline unit value on new plants entering the industry.

Under Case B total costs are estimated and the treatment costs are larger (up to $3.10 per CRT for a small plant with low production). Even so, higher treatment costs per tube for new plants under Case B will not be as severe as one might expect due to the high value of the product ($253.30 for CRT versus $91.18 for color TV picture tubes). Case B analyzes the total cost for Option 3 compared to the raw waste load. Treatment costs

estimated per CRT are less than two percent of the baseline value. For either Case A or Case B the impacts are small and not likely to pose a major disadvantage for new plants entering the industry.

New Luminescent Coatings Plants. Prices for plant output of new sources could be 0.7 to 10.5 percent higher than for existing plants. These estimates are based on a tenuous relationship of production value to wastewater flow in existing plants; the range in value per unit of flow varies by a factor of 1.5 between the high and the low. Based on larger plant sizes (i.e., 100,000 gpd or greater) and on average value per unit of flow, treatment costs are 1.5 percent or less of production value.

The tentative conclusions are: 1) the additional cost burden will not discourage new plants being built by large firms whose product lines are very likely to be vertically integrated with coating production; and 2) treatment costs for small plants, not vertically integrated with CRT or fluorescent lamp manufacturing may possibly dissuade a new entry into the industry.

V.9 Small Business Analysis

Of eighteen firms included in the study, the six smallest in terms of sales incur no incremental costs under Option 2 or Option 3. For five of these, corporate sales are not available and the plants are treated as if they are the firm; their sales range from $13.5 million for Thomas Electronics to $1.5 million for on plant owned by B-Scan Inc. (For Special Purpose Tech and Tex-Video Man. sales are not available).

The eleven largest firms incur all of the treatment costs for both Option 2 and Option 3. For these firms, sales range from $27 million for General Electric to $400 million for Thomas Electronics.

The twelfth largest firm is Clinton Electronics based on sales of one plant at $41.2 million. Corporate sales are not known. However, employment of 700 for Clinton Electronics suggests that the firm is not a small business.

VI. Limits of the Analysis

The results of the analysis depend on several major assumptions and on the accuracy of the data used in the calculations. These are discussed next.

VI.1 Plants With Multiple Product Lines

There is a lack of information on product lines for each existing plant, particularly sales data on product lines affected by treatment cost. There-

fore, treatment cost ratios are based on plant sales. If additional wastewater treatment is needed for only cathode ray tubes or luminescent coatings and the plant has other product lines, then the impacts are underestimated.

VI.2 Impact Measure Derivatives

Impact measures, other than treatment cost to sales ratio, are derived on aggregated data of the four-digit SIC level and the data are not up-to-date. Individual plants are analyzed as if they operated with the average values (of sales to manufacturing cost, sales to plant profit, sales to annual plant investment) for the four-digit SIC group for the three industry subcategories. In addition, the averages are calculated from 1977 Census of Manufacturers data.

VI.3 Discount Factors

Annual costs are based on 13 percent discount rate and a five-year life for the capital investment portion of treatment costs. Two alternative discount rates, 10 and 16 percent, were also analyzed. For color TV picture tubes and other CRTs, annual treatment costs are changed by five percent or less from those used in the study. The impact ratios are altered by no more than 0.028 percentage points for color TV tubes and by no more than 0.15 percentage points for other CRTs. None of the conclusions stated earlier would change if the alternative discount rates had been used.

VI.4 Small Companies

Small plants are likely to be privately owned. Privately owned firms are not required to provide financial data for public use, therefore financial ratios cannot be calculated to help in judging the financial condition of small companies and the potential severity of impacts.

This limitation not withstanding an analysis was conducted to determine whether small firms bear disproportionate impacts. Six firms from the study sample of eighteen employ fewer than 250 persons and can be considered small and none of these firms incur treatment costs. The twelve largest firms incur all of Option 2 treatment costs ($2,869,800). The same is true for Option 3; where the twelve largest firms incur all the treatment costs of $3,055,900.

VI.5 Import Policies

If U.S. levels of production decline, existing plants may be more adversely impacted than the estimates show because costs will be spread over a lower base. Imports of TV picture tubes have increased annually in recent years; but the future trend is uncertain. The tubes are used in TV sets and anti-dumping regulations imposed on Japanese sets by the U.S. may or may not

continue. New regulations that apply to the picture tubes as well as the TV sets could also affect U.S. production, although pressure for such regulation has not been observed.

Section 2

Industry Profile

I. Industry Definition

This study is concerned with three segments of manufacturing that are part of, or related to, the electronic tube industry. The three segments include the manufacture of (1) color television picture tubes--a particular type of cathode ray tube, (2) other cathode ray tubes and (3) luminescent coatings.

Color TV tubes produce images by controlling a stream of electrons which strike a surface coated with phosphors resulting in luminescence. Other cathode ray tubes (i.e. other than color TV tubes) use these same principles for display and the storage of data in many different types of equipment such as scientific and engineering instruments, oscilloscopes, industrial controls, computers, word processors and military equipment such as radar, fire control and navigation systems. Luminescent coatings are used in the manufacture of cathode ray tubes (CRT) and also in fluorescent lamps.

There are many types of electronic tubes other than CRT's such as radio and television receiving tubes, power tubes and a wide variety of special purpose tubes. However, the effluent discharges resulting from their manufacture are from metal finishing processes and will not be controlled under this regulation.

II. Industry Overview

Color TV picture tubes and other CRT's are but two of a large number of products associated with the electronics industry. Before analyzing the particular segments that are the focus of this study, an overview of the electronics industry is presented.

A rough breakdown of factory sales of electronic equipment, systems and components is shown in Table 2-1.[1/] Factory level sales of electronic components in 1981 accounted for $24.4 billion, or 21.4 percent of the $114 billion electronics industry total. Electron tubes are but one group of electronic components; tube sales totalled about $2.0 billion of which $1.1 billion is attributed to TV picture tubes, most of which were color tubes. (In 1981 about 11.1 million color TV tubes were sold, valued at $998.7 million.) Thus, color TV picture tubes account for approximately 50 percent of all electron tube sales, 4.5 percent of all electronic components and slightly less than one percent of total U.S. industry-wide factory sales of electronic equipment, systems and components.

Sales of power, transmitting and special purpose tubes amounted to $845 million in 1981. Electro-optical devices show sales of $337 million and included other CRT's (other than TV picture tubes).

Five firms manufacture color television picture tubes (RCA, Zenith, GE, N.A. Philips and Sony). We estimate that 14 to 16 firms make other CRT's including two large producers, (Hewlett Packard and Tektronix) and eleven or

Table 2-1

1981 Factory Sales of Electronic Systems and Components

	Billions of Dollars	Percent of Total
U.S. Industry Wide Factory Sales	114.0	100.0
Consumer Electronics (e.g. stereo equipment, TV sets)	11.4	10.0
Industrial Electronic Products, including computers & related products	43.5	38.2
Communications Equipment & Systems	34.7	30.4
Electronic Components	24.4	21.4
Electron Tubes	2.0	1.8
TV Picture Tubes* (color and monochrome)	1.1	0.9
Radio and TV Receiving Tubes	0.1	0.1
Power & Transmitter & Special Purpose Tubes	0.8	0.7
Solid State Products (e.g. transistors, diodes and rectifiers, integrated circuits, other semi-conductors	7.8	6.8
Passive Components (e.g. capacitors, resistors)	2.9	2.5
Other Components	11.6	10.2

Source: Derived from 1982 Edition Electronic Market Data Book, Electronic Industries Assoc. (EIA)

*Includes Imports of $71 million which EIA includes in U.S. Industry-Wide Factory Sales

twelve smaller producers. (Bureau of the Census information indicates that fourteen firms make industrial and military-type CRT's[2/]). Five firms produce luminescent coatings, based on information collected by the EPA.

Employment in 1980 for electronic components (i.e., establishments classified in SIC 367) totaled 498,600 of which 336,600 were production workers. The electronic tube sector, all types (SIC 3671), accounts for eight percent of all employment in the components sector. In contrast, the semiconductor sector (SIC 3674) accounts for about 30 percent of all employment in the electronics component sector.

III. Growth History and Outlook

III.1 Production and Factory Sales

III.1.1 Electron Tubes All Types. The growth history of electron tube sales (all types) has been sluggish since 1971. Analysis of this history differs depending on the data source. Data from the Electronic Industries Association (EIA) in Table 2-2A, shows that sales of electron tubes have increased at an annual current dollar rate averaging six percent since 1971 except for a downturn during the 1975 recession. In 1981, sales were $2.014 billion; over the 1972-81 period the data show that real growth (i.e., in constant dollars) averaged only 0.6 percent annually. According to the U.S. Department of Commerce data shown in Table 2-2B, value of product shipments of electron tubes grew at average annual rate of 3.6 percent from 1972 to 1981 (in current dollars)[3/] but in real terms, the value of shipments decreased at an average rate of 1.1 percent per year during that nine year period.*

A major reason for the sluggishness suggested by both industry and government trends is the poor performance of the radio and television receiving tubes segment of the industry. This segment is being affected by a continuing shift to solid state technology. Increased import penetration into the US market is another important factor in the decline of receiving tubes. As a result, shipments of US-made receiving tubes (expressed in current dollars) have decreased 10 percent annually since 1972.

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* Product price index applied to data in Table 2-2 to estimate constant dollar growth rates.

Table 2-2. Annual U.S. Manufacturer Sales of Electron Tubes, Selected Types, and Color Television Receivers

(Millions of Current Dollars)

Table 2-2A.

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Electron Tubes, All types	1094	1258	1338	1196	1071	1233	1296	1451	1586	1778	2014
Color Television Picture Tubes	470	590	676	569	463	586	586	682	761	912	999
Electro-Optical Devices*	80	112	133	138	149	173	215	268	307	307	337

Source: Reference 1; pp. 87, 88, 92.

Table 2-2B.

	1972	1977	1978	1979	1980	1981	1982
Electron Tubes, All Types	1189	1257	1428	1526	1680	1636	1718

Source: Reference 3; p. 237.

Table 2-2C.

1975	1976	1977	1978	1979	1980	1981
2268	2755	3289	3674	3685	4210	4349

Source: Reference 1, Page 6.

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* Includes Industrial and Military Cathode Ray Tubes.

The outlook, according to U.S. Department of Commerce projections, is that sales of electron tubes (total, all types) are expected to move in a downward trend at an inflation-adjusted rate of 0.4 percent per year through 1986.[3] Industry forecasts show an annual (current dollar) growth rate of 5.7 percent in sales from 1981 to 1985.[4] If a six to seven annual percentage rate of inflation is assumed, then the two projections are about the same. Using a sales value of $2.014 billion in 1981 and a 0.4 percent annual decline, the projected 1985 sales value is about $2.0 billion, expressed in constant 1981 dollars.

III.1.2 Color TV Picture Tubes. Color TV picture tube sales showed an eight percent annual (current dollar) growth during the 1971-81 period except for the 1975 drop, as presented in Table 2-2A. Expressed in constant dollars, this industry segment's sales increased by 1.2 percent per year.

Manufacturers' sales of color television receivers grew by 11 percent per year (in current dollars) from 1975 to 1981 while picture tube sales grew by 14 percent annually in the same period (see Table 2-2C). The color TV picture tube sales trend appears to generally follow that for receivers but with a higher rate of growth in value. The factors behind this trend can be seen in Table 2-3. Initial equipment sales grew rapidly in the late seventies (15 percent per year, in current dollars) but declined in 1981. Renewal sales and exports show a marked decline since the mid-seventies while imports have increased.

According to industry forecasts, the long-term outlook for color TV picture tubes is that annual sales are expected to grow at a rate of 6.9 percent (current dollars) from 1981 to 1985.[4] Allowing for an average annual rate of inflation of five to six percent, 1985 sales will be five to nine percent greater than 1981 sales, in constant dollars. There is a growing demand for color television receivers for the consumer market due, in part, to the many new uses for the TV screen that are being developed. The color TV is the basic visual display device for several new television technologies such as video games, video cassette recorders, and home computers.

There do not appear to be any technological innovations that would have an adverse impact on the TV picture tube market in the near future. Flat display tubes using semiconductor and/or liquid crystal technology have been demonstrated. However, substitution of such tubes for the cathode ray type tube will probably not be evident until the 1990's.[5]

III.1.3 Other Cathode Ray Tubes (CRT). Sales of electro-optical devices, which include cathode ray tubes for non-television uses, grew rapidly at an average annual rate of 13 percent per year from 1972 to 1981, as shown in Table 2-2A. Even when expressed in constant dollar terms, growth was substantial; an average rate of eight percent per year.

Table 2-3. Annual Factory Sales of Color Television Picture Tubes by Market (Thousands of Units and Dollars); United States, 1971-1981*

Units	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Initial Equipment	5,647.6	6,950.7	7,824.1	6,548.5	5,205.2	6,186.1	6,821.7	8,181.0	9,124.0	10,623.1	10,048.1
Renewal	873.6	856.6	896.9	784.2	697.0	696.7	577.2	456.1	406.5	361.7	362.8
Export	222.1	622.3	976.9	845.8	871.2	1,484.4	1,139.4	958.8	973.3	940.0	675.7
Import	122.4	115.1	81.6	45.9	89.2	191.6	289.9	297.1	354.7	590.3	984.2
Total Units	6,865.7	8,544.7	9,779.5	8,224.4	6,862.6	8,558.8	8,828.2	9,893.0	10,858.5	12,515.1	12,070.8
DOLLAR VALUE:	474,000	595,212	679,025	571,219	469,202	598,414	601,543	699,002	783,228	944,782	1,051,639

*Excludes sales by local rebuilders.

Source: Reference 1, page 89.

According to EIA estimates, industrial and military type CRT's represented about 35 percent ($118 million) of electro-optical factory sales in 1981.[1] Using this $118 million estimate in conjunction with unit value of the factory level from the 1980 Annual Survey of Manufacturers, a 1981 average price is estimated at $210 to $225 per CRT, implying a production level of 550,000 to 600,000 units. (The 1980 Survey indicates 367,000 units with a value of $72.1 million.) It can safely be assumed that growth of CRT sales equalled or exceeded the trend of the larger, electro-optical segment of the industry.

The outlook for industrial and military CRT's is excellent; the industry forecasts the sales value to increase at an annual rate of about nine percent (in current dollars) from 1981 to 1985. Allowing for an average annual rate of inflation of five to six percent, 1985 sales will be 15 to 19 percent greater than 1981 sales, in constant dollars. This is the segment of the electro-optical devices sector expected to achieve the highest growth rate.[4] The current Administration's committment to increased expenditures for the Department of Defense, combined with a growing proportion of electronics equipment in military hardware, supports these growth projections. Increasing demand by business for the capabilities offered by data display devices (which allow easy access to information) will be another source of long-term growth in CRT sales. Expanded consumer use of personal computers and terminals is also expected to raise demand for CRT's. Color is an additional feature of CRT screens that will be in demand for such uses as computer terminals and airline cockpit displays. Technologies like these will promote speedy growth of industrial-military CRT sales in the future. Display innovations, such as those using lasers, are not expected to hurt CRT sales and could expand them by stimulating the development of new, previously unattainable, applications.[1]

III.2 Employment

Employment in the electron tube industry (SIC 3671) has increased slightly over the past ten years, at an average rate of 0.05 percent per year according to U.S. Department of Commerce and U.S. Department of Labor data. Table 2-4 shows total employment to be 43,500 in 1981 of which 26,700 were production workers. The same data sources indicate an historical decline in the number of production workers of 1.8 percent annually. The U.S. Industrial Outlook for 1982 reports an annual decrease in total employment in the electron tube industry two percent between 1972 and 1981 and a decline of 2.3 percent per year in production workers over the same period.[3]

Figures for the radio and television receiving tubes sector (SIC 36711) are not available, however, as mentioned earlier, this is a declining industry segment due to technological innovation and product substitution as well as import penetration.

Based on historical trends, the outlook for employment in other parts of the electron tube industry such as color TV and other cathode ray tubes may

Table 2-4. Average Annual Employment, Electron Tubes, All Types (SIC 3671), 1971-1981
(In Thousands)

	1971	1972	1973	1974	1975	1976	1977*	1978	1979	1980	1981
All Employees	43.3	47.1	49.7	44.0	37.8	37.6	36.7 (42.8)	42.6	44.0	45.5	43.5
Production Workers	31.9	34.0	36.4	32.7	27.3	27.8	27.5 (27.5)	28.0	28.2	28.4	26.7

*Data in parentheses for the year 1977 and for the following years are from the second source listed.

Sources: Reference 10, page 36E-7 (years 1971-1977); Reference 1, page 117 (years 1977-1981)

be better than is apparent from the overall industry data. Bureau of Labor Statistics forecasts show increases in employment ranging from 1.7 to 2.5 percent per year between 1980 and 1990 for the electronics industry as a whole.[1/]

III.3 Prices

Based on the value of manufacturer's shipments, 1980 prices of color television tubes averaged $76 per unit for domestic tubes (this average reflects a range of $62 for 17 inch tubes to $92 for tubes 20 inches and over as shown in Table 2-5A), and $56 per unit for imported tubes. Considering all sizes of tubes, data from the EIA indicate that price of tubes made in the U.S. in 1981 was $90, up 18 percent in one year while import prices declined. These data also reveal that increases in U.S. color TV picture tube prices averaged about three percent annually from 1972 to 1981 (in current dollars).

The average price of industrial and military-type cathode ray tubes was $197 in 1980. (With available production data it is not possible to estimate price differences between CRT prices purchased for industrial use and those for military purposes.) As shown in the table, prices of color television picture tubes have increased (in current dollars) between two percent and eight percent per year, depending on tube size, over the 1977 to 1980 period. Industrial-military CRT prices rose 33 percent annually during the same period.

Import prices increased four percent per year from 1971 to 1981 (in current dollars) but have remained lower than U.S. prices, as shown in Table 2-5B. In 1981, for example, the average price of a color TV picture tube import was $54, or 60 percent of the U.S.-made average picture tube price. In constant dollars, import prices fell at an average annual rate of 2.3 percent while domestic prices fell at an average annual rate of 1.8 percent between 1972 and 1982. (This is due, in part, to a different mix of tube sizes among imports compared to U.S-made tubes.) An important factor in the outlook for the TV picture tube market will be the impact of Japanese imports (see Foreign Trade).

The average color television receiver price (in current dollars and including both imports and U.S. made products) in 1981 was $377, in 1980 was $369 and in 1979 was $360, based on factory sales.[1/] This suggests that, at the factory level, color TV picture tube prices recently have been twenty to twenty-five percent of receiver prices. However, another source indicates that the ratio of TV picture tube price to TV set price at the retail level was about 40 percent several years ago.[7/] Costs of TV set components--other than the picture tube--are expected to decline due to the use of integrated circuits and other innovations, therefore, the ratio of the picture tube to receiver price will probably start to increase.

Table 2-5 Average Factory Level Prices of Electron Tubes, Selected Types *

Table 2-5A
($/unit)

	1972	1977	1979	1980
Color Television Tubes:				
17 Inch and Under	69**	58	56	62
18 and 19 Inch		61	62	73
20 Inch and Over		74	81	92
Other Cathode-Ray Tubes:				
Industrial and Military	NA	83	169	197

Source: Reference 6. Table 4, (years 1979, 1980) and Reference 10, page p. 36E-23, (years 1972, 1977).

Table 2-5B
($/unit)

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Color Television Tubes:											
U.S.	70	70	70	70	68	70	69	71	72	76	90
Imports	35	44	36	53	67	65	54	56	62	56	54

Source: Reference 1, pp. 87, 88.

*Average prices based on value and quantity of shipments.

**Average, all sizes

III.4 Markets

Market data are available for the electron tube industry in terms of the value of purchases made by original equipment manufacturers (OEM), broken down into four categories:

- Commercial - business and government (civilian), transportation (other than consumer) and similar uses;
- Consumer - entertainment equipment, automotive electronics, appliances and home applications;
- Industrial - manufacturing, instrumentation, medical, process control, machinery and utilities; and
- Military and space.[8/]

The market category into which a component is classified is determined by the end user of the equipment that incorporates the component. Table 2-6 presents market data for electron tubes--all types, color television tubes, and other cathode ray tubes. The basis for the data shown differ from U.S. manufacturers sales data in several important ways: imports and distributors' margins are included, while exports, replacement components and captive production are excluded.[8/] Consider captive production, for example. The major portion--possibly all--the output of two of the producers of industrial and military cathode ray tubes (Hewlett Packard and Tektronix) is for their own use, and therefore not included. Nevertheless, the relative importance of different markets can be roughly outlined.

For electron tubes, total all types, the main market is industrial (35 percent), although consumer (29 percent) and military and space (24 percent) are very important. The fastest growing area since 1979 is the commercial market which has grown at an average rate of 14 percent per year. Consumer uses declined at an average rate of four percent per year between 1979 and 1982.

By far the major market for color TV picture tubes is consumer uses (92 percent). However, this market share has declined at an average rate of four percent since 1979 while the other three markets (accounting for eight percent of TV picture tube OEM purchases) have grown rapidly.

For other cathode ray tubes, all four markets are growing at an average rate of 16 percent, industrial uses have grown more rapidly than the others, at 23 percent annually. The largest CRT market is commerical with over one-half the total value of purchases in 1982. The military and space CRT markets are also important and growing rapidly.

Table 2-6. Original Equipment Manufacturers Purchases by End-Use Market, Electron Tubes, Selected Types; United States, 1979-1982
($ million)

	1979	1980	1981	1982*	Percent of Total, 1982	Average Annual Growth %
Electron Tubes, All Types:						
Commercial	53	64	69	78	11.8	14
Consumer	217	194	193	190	28.7	-4
Industrial	201	218	232	234	35.3	5
Military and Space	131	141	147	160	24.2	7
Total:	602	617	641	662	100.0	3
Color Television Tubes:						
Commercial		1	1	2	1.1	41
Consumer	182	162	164	160	92.0	-4
Industrial	2	3	5	6	3.4	44
Military and Space	3	4	5	6	3.4	26
Total:	187	170	175	174	100.0	-2
Cathode Ray Tubes, Except TV:						
Commercial	42	51	56	62	55.4	14
Consumer	4	5	6	7	6.3	21
Industrial	13	18	22	24	21.4	23
Military and Space	12	14	16	19	17.0	17
Total:	71	88	100	112	100.0	16

Sources: Reference 8, p. 53 (year 1979);
* Reference 9, p. 104 as reported in Predicasts, Forecast Abstracts, pp. B-242, B-243 (years 1980-1982).

III.5 Foreign Trade

The history of foreign trade in color TV tubes is linked to foreign trade in color TV sets. The U.S. Tariff Act of 1980 invoked an anti-dumping order on the import of Japanese color TV sets. This order was continued in 1981 and complicates the outlook for color TV's in this country. Partly as a result of the antidumping order, Japanese firms have opened manufacturing plants in the U.S.

U.S. manufacturers of TV tubes desire stricter import rules and allege that they are adversely affected by "dumping" practices of the Japanese tube manufacturers.[5] The outcome of current litigation concerning TV receiver sets and the past U.S. policy aimed at prohibiting dumping of foreign TV sets on the US market is uncertain and may affect TV picture tube imports. Talks between the U.S. and Japanese governments may encourage self-imposed limitations on television picture tube exports by Japanese manufacturers, but long-term policies are unclear.

Annual imports of electron tubes--all types--have been steadily increasing since 1977 at an average rate of 18 percent (see Table 2-7). Imports of electron tubes and related products totaled $300 million in 1981, up 17 percent in current dollars over the 1980 value of $256.9 million. Imports were equal to 15 percent of U.S. sales in 1981.

Imports of color TV picture tubes have been increasing by 36 percent per year from 1977 to 1981 (see Table 2-7). The 1981 value of picture tube imports, $53 million, was 59 percent higher than the 1980 value of $33 million in current dollars. Sixty-seven percent more color TV picture tubes (i.e. units) were imported in 1981 (984.2 thousand) than in 1980 (590.3 thousand).[1] Imports accounted for nine percent of the quantity and five percent of the value of annual U.S. factory level sales of color picture tubes in 1981. Almost all (97 percent) color picture tube imports come from Japan.

The value of imports of other cathode ray tubes increased 30 percent from $21 million in 1980 to $28 million in 1981 (see Table 2-7). The average annual increase over the period 1977-1981 has been 55 percent expressed in current dollars. Imports were about 24 percent of U.S. sales of "Other CRT's" in 1981.

Exports of electron tubes have also been rising since 1977, at an average rate of 12 percent annually (see Table 2-8). This rate is lower than that of imports. Exports of electron tubes and related products totaled $377.3 million in 1981, four percent above the 1980 value of $361.1 million. The recent balance of trade for electron tubes is positive, as shown in Table 2-9. Exports equaled nineteen percent of US factory sales in 1981.

For electron tubes--all types--the balance of trade increased 5.8 percent between 1977 and 1980 and then declined 26 percent in current dollars, between 1980 and 1981 (from $104.2 million to $77.3 million). The overall average annual growth rate from 1977 to 1981 was 1.4 percent.

Table 2-7. Annual Imports of Electron Tubes

Selected Types ($ million)
United States, 1977-1981

	1977	1978	1979	1980	1981
TV Picture Tubes, Color	$15.5	$16.6	$22.0	$33.3	$52.9
TV Picture Tubes, B/W	4.7	8.3	10.0	10.5	15.3
Cathode Ray Tubes, NES*	4.8	7.3	13.2	21.3	27.6
Parts of CRT's, Including Glass	38.8	50.3	75.5	76.8	86.7
Electron Tubes, All Types	156.0	183.4	232.0	256.9	300.0

*NES = Not elsewhere specified.

Source: Reference 6.

Table 2-8. Annual Exports of Electron Tubes

Selected Types ($ million)
United States, 1977-1981

	1977	1978	1979	1980	1981
TV Picture Tubes, Color	$75.7	$67.4	$80.9	$82.0	$65.8
TV Picture Tubes, B/W	1.2	1.8	1.7	1.2	1.3
Cathode Ray Storage Tubes	5.0	5.8	6.6	8.1	9.4
Cathode Ray Tubes, NES	11.4	25.8	40.2	44.3	56.1
Parts, etc., NES* Including CRT Glass	63.7	65.8	101.2	100.1	108.3
Electron Tubes, All Types	239.1	256.2	327.8	361.1	377.3

*NES = Not elsewhere specified.

Source: Reference 6.

Exports of color TV picture tubes have equaled seven percent of the value of U.S. factory sales in 1981 and have had a mixed history (see Table 2-8). From 1977 to 1981 there was an average annual decline in exports of three percent with a 20 percent decline between 1980 and 1981 (from $82 million to $66 million in current dollars). Imports of color TV tubes, on the other hand, increased between 1977 and 1981, and this has resulted in a five percent decline in the balance of trade over the past five years (see Table 2-9). The decline in color TV picture tube balance of trade between 1980 and 1981 was 73 percent.

Exports of other cathode ray tubes increased 25 percent in current dollars from $52.4 million in 1980 to $65.5 million in 1981 (see Table 2-8). Since 1977, exports have been increasing at an average annual rate of 41 percent. The value of other CRT exports came to 56 percent of US sales in

1981, a significant factor in this segment's market. The balance of trade of other CRT's is positive and increasingly favorable as shown in Table 2-9.

IV. Firms and Establishments in Scope of Study

There are five known firms in the US which make color television picture tubes. The five producers supply about 15 firms--including their own--which manufacture color TV sets.

Thirteen firms manufacture other CRT's with a significant part of their production used captively in the production of engineering and scientific instruments. Five firms produce luminescent coatings. The major companies are listed in Table 2-10 along with the sample of plants included in this study; there are seven color TV picture tube plants, 1.5 other CRT plants and five luminescent coatings plants.

The firms that manufacture the color television tubes are all large, publicly owned companies which also manufacture color television receivers and therefore, in this respect are vertically integrated "downstream". Three firms (possibly four) make the basic glass enclosure, the raw material item that color television tubes are made from; the three are: Owens-Illinois, Corning Glass, and Lancaster Glass.[1/] Thus, none of the color TV tube manufacturers are vertically integrated "upstream" with respect to the basic glass enclosure. Two firms each have two color TV tube production plants.

Table 2-9. Balance of Trade of Electron Tubes

(1977-1981/$ Million)

	BALANCE OF TRADE		
Year	Color TV Tubes	Other CRT's*	Electron Tubes, All Types
1977	60.2	11.6	83.1
1978	50.8	24.3	72.8
1979	58.9	33.6	95.8
1980	48.7	31.1	104.2
1981	12.9	37.9	77.3

*Includes both Cathode Ray Storage Tubes and Cathode Ray Tubes, NES, from Tables 2-7 and 2-8.

Source: Reference 1.

Table 2-10. Firm and Plant Characteristics for Industry Segments

Industry Segment	Firms	No. of Plants[1]	Ownership		Daily Plant Production[1]	Percent of Total Daily Plant Production[1]
			Public	Private		
Color TV Tubes	RCA	2	x			31
	Zenith	1	x			28
	ECG Philips	2	x			19
	GE	1	x			12
	Sony	1	x			10
					Annual Sales ($ million)[1]	Percent of Total Annual Sales[1]
Other CRT	Tektronix	1	x		545.5	65.5
	Hewlett Packard	1	x		93.5	11.2
	Westinghouse	1	x		72.0	8.6
	Clinton Electronics	1		x	41.2	5.0
	Litton Industries	1	x		36.3	4.5
	Dumont Electron	1		x	13.5	1.6
	General Atronics (N.A. Philips)	1	x		12.5	1.5
	Thomas Electronics	3		x	11.6	1.6
	Video Display Corp.	1		x	2.1	.2
	Raytheon Co.	1	x		1.9	.2
	B-Scan Inc.	1		x	1.5	.2
	Special Purpose Tech.	1		x	NA	NA
	Tex-Video Man.	1		x	NA	NA
					Annual Sales ($ million)[1]	Percent of Total Annual Sales[1]
Luminescent Coatings	GTE (N.A. Philips)	1	x		26.7	47.6
	RCA	1	x		117.2	25.7
	Westinghouse	1	x		104.6	23.0
	GE	1	x		13.1	2.9
	U.S. Radium	1	x		3.6	.8

[1] Refers only to known plants.

Source: Data are from Proposed EPA Development Document; Form 10-K reports (ownership); Economic Information Systems data service (annual sales).

Four of the firms produce an estimated 90 percent or more of total color TV picture tubes in the U.S. The top two firms are RCA and Zenith but their share of total production is not public information.

The industry segment producing other CRT's includes 15 firms; this is a dynamic business and not all small manufacturers may be known to us at this time. The industry segment EPA has identified includes 13 firms of which two, Tektronix and Hewlett Packard, are large producers of CRT's; most, perhaps all, of their CRT production is for captive use in the electronic instruments they manufacture.

Four firms in the CRT plant sample are medium-sized producers based on plant-level sales data while six are very small. Only one firm in the sample, Thomas Electronics, has multiple (three) plants. Four of the major CRT producers are publicly owned firms (Tektronix, Westinghouse, Hewlett-Packard and Litton); the ownership status of Clinton Electronics is not known. Only one of the other nine firms is publicly owned; the rest are private.

The other CRT industry segment may be more competitive than the color TV picture tube segment, due to the larger number of producers making other CRT's. However, the products of each producer may be so specialized that competition is not a major factor in CRT prices. This suspicion is supported by the fact that CRT sales for military purposes account for a sizeable share of current sales and that share is increasing.

The CRT industry segment appears to be as concentrated as the color TV picture tube segment; among the firms whose plants are included in the scope of study, the top four account for almost 95 percent of the total sales of the CRT plants included in the study. It should be noted that the available sales data are plant-wide sales and therefore may include sales of products other than CRTs made at the plants. As mentioned above, at least two of the firms are vertically integrated downstream, producing CRT's for use in scientific-engineering instruments and other products they manufacture.

The luminescent coatings industry segment is characterized by a few large, publicly owned firms. Each firm has a single plant for producing the coatings and most are vertically integrated from the production of the phosphors to their use in the manufacture of color television tubes other CRT's or fluorescent lamps. RCA produces phosphors only for TV, Westinghouse only lamp phosphors, while the rest produce both. About 90 percent of total annual sales in the sample are attributed to three plants.

Of all plants in the three industry segments under study, 12 are located in the Mid Altantic region of the U.S, five in the Mid-West, seven in the Western region and one each in the south and eastern regions.

Employment in each of the four color TV tube manufacturing plants for which data are available is between 1000 and 2600 in tube production and up to 3000 in total plant employment. There is a wide range in employment

levels in the other CRT plants in the sample. Of the nine plants for which data are available one (Tektronix) has 1000 CRT production employees and 12,000 total plant employees, one (Hewlett Packard) has 400 production workers in CRT and 2,300 total plant, three plants have between 30 and 120 production workers and four very small plants have less than 20. Employment figures are not readily available for the luminescent coatings manufacturers.

Product diversification data at the plants are not available. Using very gross indicators (total employment versus product-specific employment and total flow versus product-specific flow), it appears that three color TV picture tube plants may make other products, two CRT plants are known to be diversified while five more may be, and two luminescent coatings plants probably make other products. A 1982 catalogue of product listings show that, within the other CRT segment, General Atronics makes only non-TV tubes while the following plants make the following additional products:[9/]

Clinton Electronics Group:	Black and white TV tubes
Litton Industries:	Microwave and other special purpose tubes
Thomas Electronics, Wayne, NJ:	Electrostatic printing and black and white TV tubes
Thomas Electronics of California:	Electrostatic printing and black and white TV tubes

No other plants in the three industry segments samples are listed in the catalogue.

Section 2

REFERENCES

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8. Electronic Business, January 1981.

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10. U.S. Department of Commerce, 1977 Census of Manufacturers.

Section 3

Economic Impact Methodology

The economic impact methodology is performed in seven steps. First, the methods used to estimate a baseline projection for each of the three industry subcategories (color TV picture tubes, other CRT's and luminescent coatings) are discussed. Second, several measures are developed to analyze the impacts of treatment costs at the industry-level and the plant and firm level. Third, the approach used to analyze potential closures of existing plants resulting from treatment costs is described. In the fourth and fifth steps, the methods for estimating possible effects on production/employment and foreign trade are presented. Methods to estimate treatment cost impacts on new sources are discussed in the sixth step and the section concludes in the last step by describing how the analysis of impacts on small businesses is conducted.

I. Industry-wide Baseline

Estimates of production value and quantities--without additional treatment costs--serve as a baseline against which the impacts from regulatory action are estimated. Baseline projections for 1982 are developed for each of the three industry subcategories of color TV picture tubes, other CRT's and luminescent coatings.

The baseline is defined for 1982 because treatment costs have been estimated in 1982 dollars. Real growth is anticipated over the next three to five years for color TV picture tubes and other CRT's, therefore using current 1982 costs and production information should yield a somewhat higher, hence conservative, estimate of adverse impacts for existing plants than if 1985 conditions were projected.

The variables estimated in the baseline for TV picture tubes and other CRT's are: production value, quantity, unit prices and industry profit. For the luminescent coatings subcategory, production quantities are unknown and only total value of production and industry profit are projected.

Different methods are used to estimate baseline values for the three subcategories because available data are not consistent with regard to; (1) time periods for which data are reported by various sources, and (2) level of data aggregation in the different subcategories. The various methods for baseline estimation are discussed next.

I.1 Color TV Picture Tubes

The 1982 baseline values are estimated from 1980 and 1981 factory sales and quantities published by EIA (Electronic Industries Association, 1982 Edition, Electronic Market Data Book) and from the Department of Commerce estimate of 1981-82 growth in value of production (1982 Industrial Outlook).

In 1980, U.S. factory sales of color TV tubes was $911.5 million and in 1981 it was $998.7 million; a five percent increase in total value is projected between 1981 and 1982. However, the quantity of tubes manufactured in the U.S. was 11.93 million and 11.09 million in 1980 and 1981, respectively, as imported tubes increased by almost 400 thousand in that period. The 1982 baseline for U.S. production is estimated at 11.5 million tubes which is the average of the preceding two years. As noted elsewhere in the report, this stagnant condition is not expected to continue out to 1985.

The 1982 baseline estimate for the industry subcategory was checked against plant sales listed in the EIS (Economic Information System) data files. The aggregate plant sales account for 77 percent of the production value for the industry subcategory.* The profit for the subcategory is estimated by applying a ratio of profit to value of production. The ratio is derived from aggregate statistics for the appropriate four-digit SIC group. (The derivation is discussed later under plant-level impacts.) The use of a profit to sales ratio in the methodology is common to the other two industry subcategories.

I.2 Other CRT's

For this subcategory, 1982 baseline production value and quantities are estimated from 1979 and 1980 data published by the Department of Commerce, Current Industrial Reports 1980, MA-36N (80-1). The observed rates of increase in value and production identified under SIC 36713 are projected to obtain the 1982 estimates. (This method was used because no later data are available to distinguish the CRT's from other components.) The 1979-80 growth in production quantity was 19.5 percent and in unit value it was 16.0 percent in current dollars. The industry-wide projection of production value for this subcategory in 1982 is much less than the aggregate plant sales listed in the EIS file for the CRT plants identified in the Proposed Development Document; at least one very large plant, owned by Tektronix--possibly two others of Hewlett Packard and Raytheon--have major product lines other than CRT's which cannot be separated out of the plant sales data.

I.3 Luminescent Coatings

In this industry subcategory, the Department of Commerce data were not used because coatings are undistinguishable within SIC 2819, a large

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* Another method, used for the other CRT subcategory, was considered for color TV picture tubes. The 1979 and 1980 data reported by the Department of Commerce, Current Industrial Reports was used to calculate an annual growth rate in unit value and quantity. The method yielded a 1982 total value of production 1.75 times greater than aggregate sales of all seven plants (identified in the Proposed Development Document) whose sales are listed in the Economic Information Systems (EIS) data files on a plant-by-plant basis. Therefore, the more recent 1980-1982 production data published by the EIA was used.

miscellaneous group of inorganic chemicals not elsewhere classified. Therefore, industry-wide baseline values are estimated from plant data. Sales data for four of the five existing plants identified in the Proposed Development Document are listed in the EIS data file. For the fifth plant, employment information was provided by EPA and an average sales value per employee was applied to obtain annual sales for the fifth plant. The average sales value per employee was based on the EIS sales and employment data for three plants which ranged from $70,000 to $80,000 per employee. (A fourth plant showed $155,000 per employee but was not used for purposes of calculating an average value because the plants SIC classification indicates that metal working rather than coatings is the dominant manufacturing activity.)

To estimate the baseline for the total industry subcategory, the employment estimates for all five plants were aggregated and then multiplied by the average value per worker to calculate the value of total production.

II. Impact Projections

II.1 Industry-wide Impact

The ability of the industry to pass on treatment costs in the form of higher prices depends on the strength of demand, the ability of foreign-based manufacturers to take away U.S. market share, and the distribution of treatment costs among producers. If incremental unit cost increases are distributed evenly across all producers, then the costs are likely to be fully passed through because demand is strong. Costs may be unevenly distributed, in which case the price increase resulting from the pass through of treatment costs is assumed to be a production weighted average of unit treatment costs incurred by all the manufacturers.

Note that this assumption implies that average unit costs for the industry as a whole are passed through. Depending on the variability of unit costs across plants, some individual firms may experience reduced profits and other increased profits. (The latter would include plant with zero incremental costs.)

Two impact projections are made. For one impact projection--the cost pass through case--the treatment cost is distributed over the estimated production to obtain unit cost (and total production value) increases. In addition, another case is examined; treatment costs are absorbed by the producers resulting in profit reductions.

II.2 Plant-Level and Firm-Level Impacts

Five impact measures are derived to estimate the plant-level impacts of additional treatment costs. Also in the second part of this discussion, several of the standard financial ratios reported by Dun and Bradstreet that are used to estimate the financial health of firms are

developed to help in evaluating firms that incur treatment costs in their plants.

The five plant-level impact measures selected are:

1. ratio of treatment cost to plant sales;
2. ratio of treatment cost to plant-level profit;
3. ratio of treatment cost to plant manufacturing conversion costs;
4. ratio of treatment cost to profits of the firm; and
5. ratio of capital investment portion of treatment cost to annual plant investment.

These measures are used to judge the severity of additional treatment costs. More than one measure of impact is desirable because accurate information at the plant level is very limited, and confidence is not high in any one measure. Available plant-level data do not include profits, production costs and other financial data that are desirable for the evaluation of impacts. In addition, there was no 308 survey covering the manufacturing subcategories addressed in this study. Therefore the impact measures were derived using publicly available data in conjunction with a number of gross assumptions necessary for the plant-level analysis. The remainder of this discussion outlines the assumptions and data used to develop the impact measures.

II.2.1 Treatment Cost to Sales. This measure provides a gross screening criterion for identifying plants that may be severely impacted (ratios of treatment costs to sales, greater than, say, two or four percent of plant sales have been used in other EPA impact analyses for this purpose). Estimates of plant-level sales were obtained from the EIS (Economic Information Systems) data base. The EIS sales figures are projected values for 1982 based on input-output tables from the Department of Labor. Treatment cost to sales ratios were obtained simply by dividing annualized treatment cost for a given plant by the projected plant sales.

II.2.2 Treatment Cost to Plant-Level Profit. This measure can provide another relevant way to judge the ability of a plant to absorb additional treatment cost. If treatment cost is a significant portion of plant profits, and the additional costs cannot be recovered with higher prices for the plant's products, then the plant may be a candidate for closure. Ideally, the calculations should consider a profit stream over several years. However, because of data limitations, only one year is considered and plant level-profit is approximated by an industry-wide ratio, explained next.

Because plant-level profit is not known, we have developed a ratio of profit to sales at the four-digit SIC group level based on data in the Census of Manufacturers.* The profit is calculated as the residual of value added by manufacturing, less wages and depreciation. The profit ratio is obtained by dividing the residual, by value of shipments (value of shipments is considered synonomous to plant-level sales). The value of the residual in the numerator ideally should be reduced further to account for other costs such as royalty payments, licensing fees, plant utilities and maintenance costs exclusive of plant labor. However, these costs cannot be identified in the source data, therefore the residual is referred to as "unadjusted profit".

A ratio of unadjusted profit to sales was obtained at the four digit SIC code level using the 1977 census data* and then applied to 1982 plant level sales to approximate 1982 plant level unadjusted profit. As mentioned earlier, the ratio is also used at the industry subcategory level to estimate industry profits. In equation form, the relationships are as follows:

$$UP = f_{up} \times S_p$$

where

UP = unadjusted profit, plant-level

S_p = plant-level sales in 1982

f_{up} = unadjusted profit to sales ratio computed at the 4-digit SIC code level for 1977

$$= \frac{[(\text{value added}) - (\text{wages}) - (\text{depreciation})]}{[\text{value of shipments}]}$$

For color TV picture tubes, SIC 3671 was used to calculate the unadjusted profit ratio. For the subcategory Other CRT, the average of four different unadjusted profit ratios was used; these are SIC 3671--Electronic Tubes, all types, SIC 3811--Engineering, Scientific Instruments, SIC 3825 Instruments to Measure Electricity, and SIC 3829 Measuring and Control Devices, not elsewhere classified. The four SIC groups were used because cathode ray tubes are not only sold as distinct items made by manufacturers classified in SIC 36713, but are also incorporated into instrument packages sold by manufacturers classifed in the other three SIC groups. For luminescent coatings, industrial inorganic chemicals not elsewhere classified (SIC 2819) is used to derive the ratio. The unadjusted profit ratios derived from 1977 data are as follows:

Color TV picture tubes f_{up} = 0.348 (SIC 3671)

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* 1977 Census of Manufacturers, U.S. Department of Commerce, Bureau of the Census.

Other CRT	f_{up}	=	0.458 (average of four SIC groups)
Luminescent Coatings	f_{up}	=	0.383 (SIC 2819)

II.2.3 Treatment Cost to Manufacturing Conversion Cost. This measure considers treatment cost as if it were an additional production cost, necessary in the conversion of raw materials into products that are shipped by the plant. The conversion costs are those included in value added by manufacturing (excluding resales which involve no manufacturing activity) as defined by the Department of Commerce,* plus cost of energy and contract work.

As explained above for the unadjusted profit ratio, a manufacturing conversion cost to sales ratio was calculated at the four digit SIC level for 1977. The ratio was then applied to specific plant sales in 1982. In equation form, this is:

$$MCC = f_{mc} \times S_p$$

where

MCC = manufacturing conversion cost at the plant level

f_{mc} = manufacturing conversion cost ratio computed at the 4-digit SIC code level for 1977

$$= \frac{[(\text{value added by manufacturing}) - (\text{value of resales}) + (\text{fuels}) + (\text{purchased electrical energy} + (\text{contract work})]}{[(\text{value of shipments}) - (\text{value of resales})]}$$

For each of the three subcategories, the same SIC groups identified earlier were used to obtain the averages. The values are as follows:

Color TV picture tubes	$f_{mc} = 0.597$
Other CRT	$f_{mc} = 0.647$
Luminescent coatings	$f_{mc} = 0.632$

II.2.4 Treatment Costs to Firms' Profit. Manufacturing plants (or establishments) are often treated organizationally as independent profit and loss centers by the parent firm. That is, the plant manager is responsible for developing a sales plan, a budget and then carrying out all activities (such as operating the facility, purchasing raw materials, maintaining a work force, marketing the product, etc.) so that a profit results at year end.

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* 1977 Census of Manufacturers, Appendix A.

However, if capital investment is required for plant modification or new equipment, the necessary funds may be appropriated from a higher organizational level than the plant. Assuming the outlays are relatively modest, it is reasonable for the firm to consider financing the new investment from its earnings rather than by borrowed capital. Therefore it is useful to consider how additional plant treatment costs compare to the net income of the parent firm. To make this comparison, the annual treatment cost is divided by the reported net income* for the firm. This calculation is possible only for those firms that are publicly-owned and are required to report.

II.2.5 Capital Requirement to Plant Investment. The capital investment portion of treatment cost (TCC) is compared to an annual investment estimate at the plant level. The annual plant investment for each of the three industry subcategories is for one year as reported in the 1977 Census of Manufacturers at the four-digit SIC level. The same SIC groups discussed earlier for each of the three industry subcategories are used here. The plant investment for each subcategory is related to value of shipments to derive a ratio as follows:

$$CAP = f_{cap} \times S_p$$

where

CAP = Capital investment, plant-level (one year)

f_{cap} = ratio of plant investment to plant-level sales computed at the four-digit SIC code level for 1977.

$$= \frac{\text{[new capital expenditures]}}{\text{(value of shipments)}}$$

The derived values of the ratio for the industry subcategories are:

Color TV picture tubes	$f_{cap} = 0.0327$
Other CRT	$f_{cap} = 0.0361$
Luminescent coatings	$f_{cap} = 0.0541$

II.3 Financial Ratios

Production of the electronic components relevant to this study are often a small part of a firm's total output. Therefore, it is difficult to assess

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* Form 10-K, Securities and Exchange Commission, Washington, D.C. and Moodys Industrial Manual.

the impact of treatment costs on the firm except for the crude measure of treatment cost to net income discussed above. However, it is possible to gauge the relative health of a firm (without considering treatment costs) by using financial ratios. Three ratios have been selected for this analysis:

1. Current assets to current liabilities ("current ratio");
2. Sales to net working capital; and
3. Return on assets.

Before describing the ratios, it is important to note their limitations.

II.3.1 Limitations. Generally, the use of ratio analysis is a series of necessary, but not sufficient, tests. As the analyst finds satisfactory ratios, he moves on to the next test. When an unsatisfactory ratio is found, the factors involved are flagged for further investigation. The way that further investigation proceeds depends a great deal on the access to accounts and records usually considered to be proprietary by the firm. Even experienced analysts sometimes have difficulty getting to the root cause of an unsatisfactory trend revealed by a financial ratio.

The trends identified using the financial ratios represent the relationships of two financial items but the information provided is rather superficial since it does not shed light on the relative behavior of the two items. As an example, assume a rise in a firm's "current ratio" (current assets divided by current liabilities--a basic indication of a company's ability to meet payment obligations from current assets). It is not sufficient to know the ratio increased; it is more important to know why. The cause could be:

1. A rise in current assets and a decline in current liabilities;
2. A rise in both current assets and current liabilities but with current assets moving at a faster relative rate; and
3. A decline in both but with a more rapid decline of current liabilities.

In ratio analysis work, another important and most difficult problem is to establish norms of satisfactory or unsatisfactory relationships. The quality of a company's management, its policies, operations, competitive position, and future plans must also be carefully considered. Many of these factors are more closely held than financial statements. In addition, the impact of economic, technological and environmental factors, acquisitions and divestitures as well as many other factors must be considered. For example, temporary distortions in financial ratio trends can be very significant when North American Philips acquired General Telephone and Electronics' television set business in 1981.

II.3.2 Recommended Ratios. The financial relationships of each of the publicly held firms associated with manufacturing activities in the three subcategories are calculated to obtain a relatively broad view of the financial health of the firm. Particular attention is directed towards a firm's ability to incur additional debt without a major change in its financial structure. The following ratios are used in the analysis:

Current Assets to Current Liabilities. Current assets are the sum of cash, notes and accounts receivable (less reserves for bad debt), advances on merchandise, merchandise inventories, and listed federal, state and municipal securities not in excess of market value. Current liabilities is the total of all liabilities falling due within one year. This is perhaps the most common test of short-term solvency. Normally a ratio of 2 to 1 or better is considered good.

Sales to Net Working Capital. The net sales figure is divided by net working capital. This provides a guide as to the extent the company is turning over its working capital and the margin of operating funds. This ratio is a good measure of both efficiency and profitability.

Return on Assets. Profit after taxes is divided by total assets. This ratio is a key indicator of the profitability of a firm. It matches operating profits with the assets available to earn a return. Firms that have been effectively managed will have a relatively high return while the returns of less well-run businesses will be relatively low.

These three ratios are indicators of solvency, ability to meet short and long term debt, how well a company uses and controls its assets, profitability, and lastly, how successfully a business is earning a return for its owners.

III. Closure Analysis

It is possible that a plant, or product line within a plant, may close due to the burden of additional treatment cost. Lacking information about product line diversification at each plant as well as production value for each product line, a high confidence closure analysis is not feasible. Instead, judgments are made about closure possibilities by examining the values of the impact measures, the financial ratios of the parent company and other characteristics known about some of the firms.

IV. Production and Employment Impacts

Reductions in total industry output could result if cost increases due to treatment are passed on in the form of higher prices and the demand is sensitive to the price change. However, the three industry subcategories are associated with the manufacture of components--not end-products--used by downstream manufacturers. Therefore, the potential price increases

calculated for plant outputs of interest in this study are likely to be lower in terms of price changes of end-products in which the components are used. Without specific data on the elasticity of demand for the three industry subcategories, judgments are made about the production implications based on the magnitude of the potential price increases. If treatment costs are absorbed by the manufacturers then profits are reduced and there is no change in price, and hence no change in production.

Employment impacts are derived from production changes based on value of production per worker. (For example, value per worker for luminescent coatings plants average $75,000 per year as noted earlier.)

V. Foreign Trade Impacts

Foreign trade impacts are judged based on the magnitude of treatment costs, assuming they are passed through. The evaluation is made at the industry level rather than for individual plants. Judgments about foreign trade are difficult because factors other than treatment costs are important, but currently are subject to major uncertainty. These factors have resulted in, (1) U.S. firms opting to close plants here, and transferring their production overseas to other plants owned by the U.S. parent firm and (2) foreign-owned firms opting to open plants in the United States. The impact of treatment costs on foreign trade is judged in light of the magnitude of treatment cost impacts at the industry subcategory level.

VI. New Sources

Requirements for treatment by new sources can discourage, and possibly preclude, new entries in the industries of interest. To estimate the possible cost disadvantage for new sources, costs associated with higher treatment levels are postulated for new sources and compared with treatment for existing plants. The incremental cost for the higher level of treatment is attributed to the treatment requirements promulgated for new sources.

For color TV picture tubes and other CRT's, two cases relative to raw waste load are developed for new plants. Case A analyzes the impact of the incremental treatment costs between Option 2 and Option 3 because existing indirect dischargers will be required to attain a level of treatment equivalent to PSES-2. Case B analyzes the impact of the total treatment cost for Option 3 because no regulation is being proposed for existing direct dischargers and a new new direct discharger may incur the total cost between no treatment and a level of treatment equivalent to BAT-3.

Three sizes of model plants are used for the new source analysis. The plant sizes--specified in terms of wastewater flow--are based on the range of plants identified in the Proposed Development Document. The wastewater flows are related to model plant production using a range of production/

wastewater flow relationships observed for existing plants. The annual treatment cost is then compared to value of production of each model plant. The capital investment portion of the model plant treatment cost is also considered in judging the potential impacts of treatments for new sources.

VII Small Business Analysis

The Regulatory Flexibility Act of 1980 requires that the effects of proposed regulations on small businesses be considered. The analysis considers the distribution of treatment costs among firms using company sales and employment to describe the size of the firm. The proportion of total treatment costs borne by small and large firms is calculated.

Section 4

Effluent Limitations Guidelines Options

and Compliance Costs

I. Introduction

The Federal Water Pollution Control Act Amendments of 1972 established a comprehensive program to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (Section 101 (a)). To implement the Act, EPA was to issue effluent limitations guidelines, pretreatment standards, and new source performance standards for industrial dischargers. The Act included a timetable for issuing these standards. However, EPA was unable to meet many of the deadlines and, as a result, in 1976, it was sued by several environmental groups. In settling this lawsuit, EPA and the plaintiffs executed a court approved "Settlement Agreement." This Agreement required EPA to develop a program and adhere to a schedule in promulgating effluent limitations guidelines, new source performance standards, and pretreatment standards for 65 "priority" or toxic pollutants and classes of pollutants for 21 major industries (see Natural Resources Defense Council, Inc., v. Train, 8 ERC 2120 (D.D.C. 1976), modified, 12 ERC 1833 (D.D.C. 1979).

Many of the basic elements of this Settlement Agreement program were incorporated into the Clean Water Act of 1977. Under the Act, the EPA program is to set a number of different kinds of effluent limitations and standards. The following is a brief summary:

Best Practicable Control Technology Currently Available (BPT)

BPT applies to existing direct dischargers. The limitations are generally based on the average of the best existing performance at plants of various sizes, ages and unit processes.

Best Available Technology Economically Achievable (BAT)

BAT also applies to existing direct dischargers. These limitations, in general, represent the best existing performance in the industrial subcategory or category.

Best Conventional Pollutant Control Technology (BCT)

BCT replaced BAT for the control of conventional pollutants (BOD_5, TSS, oil and grease and pH). The Clean Water Act requires that BCT limitations be assessed in light of a two part "cost-reasonableness" test.

New Source Performance Standards (NSPS)

NSPS apply to new facilities which discharge directly into the Nation's waterways and are based on the best available demonstrated technology.

Pretreatment Standards for Existing Sources (PSES) and for New Sources (PSNS)

PSES and PSNS control the discharge of pollutants which pass through, interfere with, or are otherwise incompatible with the operation of a publicly owned treatment works (POTW). These limitations are to be technology-based, with PSES analogous to BAT and PSNS to NSPS.

The role of this report is to analyze the economic impact of water pollution controls on the electronics industry, specifically, color television picture tubes, other cathode ray tubes, and luminescent coatings. As required by the Clean Water Act, this study presents for consideration the projected economic impacts of complying with proposed regulations.

II. Treatment Technology Options

A total of 27 plants are covered by the proposed regulation. Treatment technologies appropriate to the two subcategories are developed in the Proposed Development Document in Section 7. The treatment technologies considered are summarized below:

II.1 Cathode Ray Tubes*

Option 1: No required treatment. The Clean Water Act and the Settlement Agreement allow exclusion of regulatory requirements under specific conditions. Thus, this is a zero cost option because current treatment of wastewater is sufficient.

Option 2: Solvent management to control total toxic organics, chromium reduction with the use of sulfuric acid and sodium bisulfite, chemical precipitation and clarification of all metals-bearing process wastes, sludge de-watering and pH adjustment.

Option 3: Option 2 plus multimedia filtration

II.2 Luminescent Coatings

Option 1: No required treatment

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* In this section color TV picture tubes have been combined with all other cathode ray tubes.

Option 2: Chemical precipitation and clarification of all metals-bearing process wastes using lime, a coagulant aid and a polyelectrolyte, sludge de-watering and pH adjustment.

These treatment options are applied to each regulation. The specific designations of options by regulation appear in Table 4-1.

Table 4-1. Treatment Option by Regulation and Type of Discharger

Option	Existing Direct 1/	Existing Indirect	New Direct	New Indirect
1	BPT/BAT-1	PSES-1	NSPS-1	PSNS-1
2	BPT/BAT-2	PSES-2	NSPS-2	PSNS-2
3 2/	BPT/BAT-3	PSES-3	NSPS-3	PSNS-3

1/ BPT, BCT, and BAT all apply to existing direct dischargers. However, BCT limitations are not being set more stringent than BPT for this industry. Hereafter, the treatment options will be referred to as BAT-1, BAT-2, etc., for simplicity.

2/ Option 3 applies only to the cathode ray tubes subcategory.

III. Current Treatment and Treatment Costs

III.1. Current Treatment

EPA contacted or visited as many of the existing facilities as possible to determine current treatment practices. Table 4-2 summarizes the treatment in place determinations.

III.2 Treatment Costing

This part covers the estimation of treatment costs for new and existing sources. In all cases, Option 1 is excluded from treatment costing because it would require no treatment of wastewater effluents.

III.2.1. Treatment Costing for Existing Sources. Model plant costs are developed in Section 9 of the Proposed Development Document. The detailed discussion of assumptions and of cost sources appear in that section. From those model plant costs (which are calculated for a variety of flow sizes), specific plant costs are determined based in EPA's knowledge of the flow size and existing treatment at each facility. EPA realizes that actual costs at each facility may differ depending upon raw waste pollutant concentrations, geographical considerations, etc. Monitoring of wastewater is required for direct and indirect dischargers. For each plant, $2,500 for capital investment and $13,000 per year for operation and maintanence is included in the treatment cost. For plants that currently are zero discharges, there are no monitoring costs.

Table 4-2. Current Treatment-in-Place by Option for Existing Sources

	Number of Plants	Option 1 BAT-1 or PSES-1	Option 2 BAT-2 or PSES-2	Option 3 BAT-3 or PSES-3
Luminescent Coatings	5			
Direct	2	2	2	NA
Indirect	2	2	1	NA
Zero	1	NA	NA	NA
Cathode Ray Tubes (CRT)	22			
Direct	1	1	1	1
Indirect	16*	16*	3	1
Zero	5	NA	NA	NA

Note: Some plants have partial treatment in-place for Option 2.

* Includes two plants for which information on current treatment is not available; one of these plants will be relocated in the near future.

Tables 4-3A and 4-3B summarize the estimated treatment costs for existing sources; annual costs shown are calculated as the sum of the investment cost annualized over five years at a discount rate of 13 percent, plus the yearly operation and maintenance cost.

Table 4-3A

BAT Treatment Costs by Option
($000)

Sub-category	Number of Plants	Number of Plants Incurring Costs		Capital Investment		Total Annual Costs	
		Option 2	Option 3	Option 2	Option 3	Option 2	Option 3
Luminescent Coatings	2	2	N.A.	5.00	N.A.	27.4	N.A.
CRT's	1	1	1	2.50	2.50	13.70	13.70
TOTAL	3	3	1	7.50	2.50	41.1	13.70

Table 4-3B

PSES Treatment Costs by Option
($000)

Sub-category	Number of Plants	Number of Plants Incurring Costs		Capital Investment		Total Annual Costs	
		Option 2	Option 3	Option 2	Option 3	Option 2	Option 3
Luminescent Coatings	2	2	N.A.	98.40	N.A.	84.9	N.A.
CRT's	14	14	14	4945.60	5648.50	2743.8	3042.25
TOTAL	16	16	14	5044.00	5648.50	2828.70	3042.25
BAT & PSES TOTAL	19	19	15	5051.50	5651.00	2869.80	3055.95

III.2.2 Treatment Costs for New Sources Because it is difficult to project the type of facility that may be built in the future, three models sizes of plants were costed for each of the two major subcategories. All treatment costs are estimated with respect to raw waste load. The model plant treatment costs are shown in Table 4-4; the estimates include the same per plant monitoring costs discussed earlier.

Table 4-4. Model Treatment Costs by Option for NSPS and PSNS*
($000)

Subcategory	Model Plant Flow Size (gpd)	Capital Investment Option 2	Capital Investment Option 3	Total Annual Costs Option 2	Total Annual Costs Option 3
Luminescent Coatings	10,000	91.1	96.1	68.2	70.3
	100,000	628.9	672.2	328.5	336.4
	250,000	1,163.2	1,255.6	589.6	628.0
CRT's	10,000	107.9	113.1	75.5	77.6
	100,000	693.0	736.3	392.1	410.0
	500,000	1,569.5	1,734.5	836.7	905.2

* NSPS and PSNS model plant compliance costs are identical.

Section 5

Results of Analysis

I. Baseline Analysis

I.1 Industry-Wide by Subcategory

Table 5-1 shows the 1982 baseline estimates for three industry segments: color TV picture tubes, other CRT's and luminescent coatings. For TV picture tubes and other CRT's, baseline values are shown for production quantity, value of production, unit price and industry profit. For the luminescent coatings, production quantities and unit prices are not known and only total value of production and industry profit are estimated.

Table 5-1

1982 Baseline Estimates by Industry Segment
(1982 $)

	Color TV Picture Tubes	Other CRT	Luminescent Coatings
Production Quantity (million units)	11.5	0.52	NA
Value of Production (million $)	1048.60	137.44	345.00
Unit value ($ per tube)	91.18	264.30	NA
Industry Profit (million $)[1/]	364.9	63.00	132.13

Notes:

NA = not available.

[1/] Industry profit based on ratio of unadjusted profit to value of shipments at the 4-digit SIC level; the ratios are:

0.348 for color TV picture tubes
0.458 for other CRT
0.383 for luminescent coatings

Sources:

For Color TV picture tubes, production quantity and value are based on 1980 and 1981 data from 1982 Edition of Electronic Market Data Book, Electronic Industries Association, and U.S Industrial Outlook 1982, U.S. Dept. of Commerce, January 1982.

For Other CRT, production quantities and value of production are derived from U.S. Dept. of Commerce, Bureau of the Census, Current Industrial Reports, 1980.

For luminescent coatings, value of production is based on (a) sales and employment for three plants in the EIS data file and (b) employment in one plant supplied by EPA.

For color TV picture tubes, 11.5 million picture tubes is the estimated 1982 production with a value of $1.05 billion based on a unit value of $91.18 per tube. Unadjusted profit is estimated at $364.90 million (based on the unadjusted profit to sale ratio of 0.348 derived in Section 3).

For other CRT's, 1982 production is estimated at 0.52 million units with a value of $138.5 million based on unit value of $264.30 per tube. The unadjusted profit for this industry subcategory is estimated at $63.4 million (based on an unadjusted profit to sales ratio of 0.458 derived in Section 3).

For luminescent coatings, total value of production in 1982 is estimated at $345 million. The unadjusted profit for this subcategory is estimated at $132.1 million (based on unadjusted profit to sales ratio of 0.383 derived in Section 3).

I.2 Financial Ratio Analysis of Firms

The ratios developed in Section 3 were calculated and are shown in Table 5-2 for ten firms; five firms are in color TV picture tube manufacturing, four in other CRT, three in luminescent coatings. Thus, of all the companies under study, financial statements were available for 10 of 21 firms. The financial statements of most of the smaller firms--privately owned for the most part--are not available.

The financial ratios in Table 5-2 are compared to industry data developed by Dun and Bradstreet and shown in Table 5-3. Of the ten firms shown in Table 5-2, six showed current ratios (assets to liabilities) of less than 2 which is a rule-of-thumb for identifying possible risk. They are RCA, GE, Sony, Raytheon, Litton, and Westinghouse. Of these, only Litton Industries has higher than average value of return on assets. However, all are somewhat above average in the net sales to working capital ratio which is perhaps the best measure of efficiency and profitability.

Based on the analysis of one year (1981) alone, not one of these firms appear financially weak, although Sony and Tektronix are at, or somewhat below, the median in all three ratios. To investigate further, each firm has also been evaluated using data covering several years (two to five depending on the data available), shown in Table 5-2. When the ratios are averaged over several years and compared to Dun and Bradstreet industry medians and high and low quartiles shown in Table 5-3, it is not surprising to note that most TV picture tube and other CRT manufacturers have experienced a number of lean years financially. Several reasons can be identified to explain this decline. First, and most importantly, each of these firms is large and diversified, producing many products, some of which have been severely affected by nationwide economic conditions. Second, they tend to be in industries under heavy pressure from international competition. Also, the performance of the dollar in relation to other currencies has made their task more difficult as have high interest and inflation rates.

Table 5-2

Financial Ratio Trend Analysis

Firm's Subcategory and Firm	Ratio Code*	Average Ratio	(Ratio Values) 1981	1980	1979	1978	1977
Color TV Tubes							
General Electric**	1	1.3	1.24	1.30	1.37		
	2	11.0	13.16	10.89	8.94		
	3	8%	8%	8%	8%		
NA Philips**	1	2.67	2.48	2.86			
(Formerly GTE)	2	3.29	3.63	2.95			
	3	5.5%	6	5			
RCA**	1	1.5	1.78	1.49	1.45	1.69	1.70
	2	8.17	10.59	7.11	7.47	5.86	6.02
	3	4.4%	1%	4%	5%	6%	6%
Sony	1	1.24	1.72	1.27	1.18		
	2	6.65	5.79	6.51	7.64		
	3	6%	6%	10%	2%		
Zenith	1	2.45	2.13	2.76			
	2	4.09	4.42	3.76			
	3	3%	2%	4%			
Other CRT							
Hewlett Packard	1	2.23	2.42	2.16	2.12		
	2	3.65	2.42	2.16	2.12		
	3	11.33%	11%	12%	11%		
Litton	1	1.51	1.53	1.49			
	2	5.2	5.19	5.21			
	3	8.5%	8%	9%			
Raytheon	1	1.33	1.33	1.32	1.31	1.35	1.35
	2	9.09	9.6	10.09	9.53	8.31	7.89
	3	9%	10%	10%	9%	8%	7%
Tektronix	1	2.75	2.67	1.79	2.8		
	2	2.87	2.96	2.80	2.85		
	3	10%	8%	10%	12%		
Westinghouse**	1	1.19	1.03	1.26	1.29		
	2	33.85	84.01	9.99	7.56		
	3	4%	5%	6%	1%		

Source: 1981, 10-K Reports.

*Firm's average for each of the three ratios is based on values over the 2 to 5 years as displayed in the table. Ratio code is as follows:

1 = Current Ratio (Current Assets to Current Liabilities).
2 = Net Sales to Net Working Capital.
3 = Return on Total Assets in Percent.

**These firms also produce luminescent coatings.

Table 5-3

Comparative 1981 Dun and Bradstreet Industry Ratios (SIC 3671-79)
Electronic Components and Accessories (108 Firms)**

	Current Assets / Current Liabilities	Net Sales / Net Working Capital	Net Profit / Total Assets
Upper Quartile	3.8	9.0	18.2
Median	2.5	4.9	10.6
Lower Quartile	1.7	3.2	6.5

Source: Key Financial Ratios in 125 Lines of Business, Dun and Bradstreet Inc. 1981.

**The Dun and Bradstreet industry (SIC) ratios are arranged in order of "quality" with the best at the top and the weakest at the bottom. The figure in the middle becomes the median for that ratio in that line of business. The upper and lower figures typify the experience of firms in the top and bottom halves of the sample. Though not relevant to the data shown in this table, it is important to note that upper quartile figures are not always the highest, nor are lowest quartile figures always the lowest numerically. The upper quartile listings represent judgmental ranking, thus the upper quartile represents the best condition in any given ratio and is not necessarily the highest numerical value.

Analysis of each of the three ratios based on the firms multi-year average, results in the following observation.

Current Ratio: Only two firms (Tektronix and N.A. Philips) exceeded the median. Since the rule of thumb for healthy solvency is 2, it is obvious that money is tight for this industry sector, however solvency is not necessarily the main issue because other ratios indicate relative strength in other areas.

Net Sales to Net Working Capital: This ratio indicates that four corporations are below the median (Zenith, Tektronix, Hewlett Packard and N.A. Philips). According to the current ratio analysis, N.A. Philips and Tektronix are among the most solvent firms in the sample. Furthermore, Hewlett Packard has one of the highest reputations among the nation's corporations. In these three cases, it is unlikely that inefficient management of assets is the cause of the relatively low ratios.

Return on Total Assets: Returns have been low for several years for almost all firms in included in the investigation. Only Hewlett Packard reached the 1981 Dun and Bradstreet median with their corporate three-year average.

Several firms come to our attention as each financial ratio is analyzed separately. When these firms' performance is evaluated with respect to all three ratios, the following observations can be made. Several firms have a relatively low solvency rating but show no marked weakness in the ratios that highlight management efficiency and profitability. Hewlett Packard, N.A. Philips, Tektronix and Zenith have relatively low net sales to working capital ratios but the first three of these are at the top of the industry in other ratios. Return on assets has been low for several years for all firms except Hewlett Packard which indicates that these are difficult economic times but none of the publicly held corporations in this study are judged to be in serious financial difficulty.

I.3 Baseline Projections

As discussed in Section 2, annual growth in color TV picture tubes between 1981-85 is anticipated to be 6.9 percent (in current dollar value) by industry observers. Allowing for a six percent annual rate of inflation over that period, the real increase (1.07 percent annually) would result in 1985 value of production that is 4.3 percent greater than in 1981. However, it seems that 1982 will show little if any growth over 1981 due to the current business slump. To meet a 1985 production value that is 4.3 percent over 1981 in three years instead of four will require an annual real rate of growth averaging 1.43 percent annually in 1983, 1984, and 1985. This accelerated pace (compared to 1.07 percent annually) does not seem unrealistic (assuming the economic downturn does not persist into 1983) in light of the expanding demand for color tubes in many different new applications as discussed earlier. Thus, the 1985 U.S. production value is projected to be $1.1 billion, in constant 1982 dollars. (This projection assumes no major changes in U.S. market penetration by imported tubes or large reduction in import share of the U.S. market due to protectionist measures adopted by the U.S. government.)

Military and industrial uses of other CRTs will create additional demand over the next several years. A nine percent annual growth over the 1981-85 period is anticipated by industry experts. Allowing for a six percent annual rate of inflation suggests that 1985 production value will be 11 percent (in real terms) over the 1982 baseline value. Therefore, the 1985 value of production is projected to be $154 million, in constant 1982 dollars.

II. Impact Analysis (Existing Producers)

II.1 Industry-Wide Impacts by Subcategory

II.1.1 Color TV Picture Tubes. Table 5-4 shows the impact of Options 2 and 3 on the TV picture tube industry subcategory. In Option 2, total annual cost is $1.907 million, and if treatment costs are fully absorbed by manufacturers, baseline profit is reduced by this amount which is 0.52 percent of the baseline profit for the industry subcategory; if costs are passed on in the

Table 5-4

1982 Impact Estimates (1982 $)
Industry Segment: Color TV Picture Tubes

	1982 Baseline[1]	1982 Impact Projections[2]			
		Option 2		Option 3	
		Costs Are Absorbed	Costs Are Passed Through	Costs Are Absorbed	Costs Are Passed Through
Value of Production; million $	1,048.60	1,048.60 (0%)	1,050.51 (+.18%)	1,048.60 (0%)	1,050.77 (+.21%)
Value per tube; $	91.18	91.18 (0%)	91.35 (+.18%)	91.18 (0%)	91.37 (+.21%)
Industry Profit; million $	364.90	362.99 (-.52%)	364.90 (0%)	362.73 (-.60%)	364.90 (0%)

[1] Baseline production is 11.50 million units.

[2] Percent changes from baseline are noted in parentheses.

Option 2 Annual Treatment cost = $1.9069 million
Option 3 Annual Treatment Cost = $2.1731 million

form of higher prices, the price is expected to rise by about $0.17 per tube which is 0.18 percent of the baseline unit price.

For Option 3 the total annual cost is $2.173 million and if treatment costs are fully absorbed, baseline profit is reduced by 0.60 percent. If Option 3 treatment costs are passed through, then the price increases by $0.19 per tube which is 0.21 percent of the baseline unit price.

II.1.2 Other CRT. Table 5-5 shows the impact of Option 2 and 3 on the other CRT industry subcategory. For Options 2, total annual cost is $864.3 thousand and if treatment costs are fully absorbed by manufacturers, baseline profit is reduced by an amount equal to the treatment cost; this is 1.37 percent of the baseline profit for the industry subcategory. If the treatment cost ($864.3 thousand) is passed on by manufacturers, the price is expected to rise $1.66 per tube which is 0.63 percent of the baseline price.

For Option 3, total annual cost is $896.6 thousand and if fully absorbed by manufacturers, baseline profit is reduced by this amount which is 1.42 percent of the baseline profit for the industry subcategory. If the treatment cost is passed through, price is expected to rise by $1.72 per tube which is 0.65 percent of baseline price.

II.1.3 Luminescent Coatings. Table 5-6 shows the impact of Option 2 on the luminescent coatings industry. For Option 2, total annual cost is $111.2 thousand and if treatment cost is fully absorbed, baseline profit is reduced by this amount which is 0.08 percent of the estimated baseline profit. If all treatment costs are passed through, price is expected to rise by 0.03 percent.

II.2 Impacts on Financial Ratios of Firms

The publicly owned companies are large and the impacts measured by the financial ratios are small. Table 5-7 compares total assets with the treatment cost for Option 3; for example, the annualized treatment costs of three RCA plants combined ($987,100) has no measurable affect on the financial ratios given that RCA's total assets are $7.8 billion. Thus, the firm-level financial ratios are insensitive to the relatively very small changes in value of assets associated with additional treatment equipment or facilities.

As discussed later in the plant-level impact analysis, one firm (Thomas Electronics) has three plants with relatively higher impacts than other plants. However, the firm is privately owned and therefore not required to publish financial data that would allow analysis of the financial ratios.

Table 5-5

1982 Impact Estimates (1982 $)
Industry Segment: Other CRT

	1982 Baseline[1]	1982 Impact Projections[2]			
		Option 2		Option 3	
		Costs Are Absorbed	Costs Are Passed Through	Costs Are Absorbed	Costs Are Passed Through
Value of Production; million $	137.44	137.44 (0%)	138.30 (+.63%)	137.44 (0%)	138.34 (+.65%)
Value per tube; $	264.30	264.30 (0%)	265.96 (+.63%)	264.30 (0%)	266.02 (+.65%)
Industry Profit; million $	63.00	62.14 (-1.37%)	63.00 (0%)	62.10 (-1.42%)	63.00 (0%)

[1] Baseline production is 520,000 units.

[2] Percent changes from baseline are noted in parentheses.

Option 2 Annual Treatment Cost = $850,600
Option 3 Annual Treatment Cost = $882,850

Table 5-6

1982 Impact Estimates (1982 $)
Industry Subcategory: Luminescent Coatings

	1982 Baseline[1]	1982 Impact Projections[2]			
		Option 2		Option 3	
		Costs Are Absorbed	Costs Are Passed Through	Costs Are Absorbed	Costs Are Passed Through
Value of production; million $	345.00	345.00 (0%)	345.11 (+.03%)	NA	NA
Industry Profit; million $	132.13	132.02 (-.08%)	132.13 (0%)	NA	NA

Option 3 not applicable (NA) to this subcategory.

[1] Baseline value of production estimated from plant level data on employment and sales.

[2] Percent changes from baseline are noted in parentheses.

Option 2 Annual Treatment Cost = $111,230

Table 5-7

Comparison of Firms' Assets
with Treatment Costs
($000)

	Total Assets	Treatment Cost (Option 3) Capital Investment	Annual
Color TV Tubes			
General Electric*	20,942,000	152.2	88.8
N.A. Philips*	1,854,100	317.4	197.0
RCA*	7,856,700	1,861.0	973.4
Sony	5,287,400	94.9	52.1
Zenith	743,200	1,663.5	877.2
Other CRT's			
Hewlett Packard	2,758,000	84.2	66.0
Litton	3,687,600	0.0	0.0
Raytheon	3,363,800	826.5	404.7
Tektronix	953,735	2.5	13.7
Westinghouse*	8,316,200	84.2	66.0

*These firms also produce luminescent coatings.

II.3 Plant Level Impacts (Existing Plants)

The impact measures developed in Section 3 for individual plants are shown in Tables 5-8, 5-9 and 5-10 for the three industry subcategories of color TV picture tubes, other CRT's and luminescent coatings, respectively. The tables also display the plant sales and annual treatment costs for Option 2 and Option 3, by plant.

II.3.1 TV Picture Tube Plants. Seven existing plants incur treatment costs under Option 2 and Option 3. Tables 5-8A and 5-8B reveal that all the impact measures based on annual costs are relatively small, less than two percent (except for one plant, Zenith, Melrose, IL.,).

For treatment cost to plant sales TC/Sp,the ratio is less than 0.57 percent for Option 3 and the ratio of treatment cost to manufacturing conversion cost TC/MCC, is less than 0.95 percent. The ratio of treatment cost to

Table 5-8A

Impact Measures: Color TV Picture Tube Plants
Option 2

Plant	Treatment Cost (Mill. $) Invest-ment	Annual	Annual Sales (Mill. $)	Impact Measures (Percent)* TC/Sp	TC/MCC	TC/UP	TC/NI	TCC/CAP
RCA, Dunmore, PA	.0025	.0137	110.9	.012	.021	.0355	.254	.0689
Zenith, Melrose Park, IL	1.5175	.8137	154.6	.526	.879	1.520	5.216	29.97
GE, Syracuse, NY	.0697	.0545	74.4	.073	.123	.210	.004	5.23
RCA, Marion, IN	1.5785	.8367	255.6	.338	.547	.940	1.549	18.72
Philips, Ottawa, OH	.2924	.1609	47.3	.340	.568	.977	.155	18.90
Philips, Seneca Falls, NY	.0025	.0137	35.5	.039	.065	.111	.138	.069
Sony, Rancho Bernardo, CA	.0025	.0137	127.2	.011	.018	.031	.048	.060
Total, Option 2	3.4656	1.9069	805.5					

Notes: Annual Sales are from EIS data file; 1982 $.

* All impact measures are shown as percents. TC = Treatment cost, Sp = Plant Sales, MCC = Manufacturing conversion cost, NI = Company net income, CAP = Annual plant investment, TCC = Capital investment portion of treatment cost.

Table 5-8B

Impact Measures: Color TV Picture Tube Plants
Option 3

Plant	Treatment Cost (Mill. $) Invest-ment	Treatment Cost (Mill. $) Annual	Annual Sales (Mill. $)	Impact Measures (Percent)* TC/Sp	TC/MCC	TC/UP	TC/NI	TCC/CAP
RCA, PA	.1265	.0682	110.9	.061	.103	.176	.126	3.49
Zenith, IL	1.6635	.8772	154.6	.567	.948	1.636	5.623	32.91
GE, NY	.1522	.0888	74.4	.119	.200	.344	.006	11.41
RCA, IN	1.7345	.9052	255.6	.354	.591	1.018	1.585	20.75
Philips, OH	.3124	.1679	47.3	.355	.592	1.020	.161	20.20
Philips, NY	.0025	.0137	35.5	.039	.065	.111	.138	.069
Sony, CA	.0949	.0521	127.2	.041	.064	.091	.018	2.282
Total, Option 3	4.0865	2.1731	805.5					

Notes: Annual Sales are from EIS data file; 1982 $.

* All impact measures are shown as percents. TC = Treatment cost, Sp = Plant Sales, MCC = Manufacturing conversion cost, NI = Company net income, CAP = Annual plant investment, TCC = Capital investment portion of treatment cost.

Table 5-9A

Impact Measures: Other CRT Plants
Option 2

Plant	Treatment Cost (Mill. $) Investment	Treatment Cost (Mill. $) Annual	Annual Sales (Mill. $)	Impact Measures (Percent)* TC Sp	TC MCC	TC UP	TC NI	TCC CAP
Raytheon, Quincy, MA	.7825	.3887	95.0	.409	1.110	.893	.120	22.81
Clinton Elec. Rockford, IL	.3025	.1297	41.2	.314	.486	.688	NA	20.33
Thomas Electronics, Clyde, NY	.0790	.0637	2.4	2.654	4.102	5.793	NA	91.19
Thomas Electronics, Wayne, NJ 1/	.0790	.0637	9.2	.692	1.070	1.511	NA	23.78
Thomas Electronics of Calif. Los Angeles, CA 1/	.0790	.0637	1.7	3.747	5.792	8.182	NA	128.72
Hewlett Packard, Colo. Spgs. CO 1/	.0790	.0637	93.5	.068	.106	.148	.024	2.34
General Atronics, Phila. PA 2/	0	0	4.5	0	0	0	0	0
Litton Ind., San Carlos	NA	NA	36.3	-	-	-	-	-

(Table 5-9A continues).

Notes: Annual Sales are from EIS data file; 1982 $. NA = Data not available.

1/ Treatment cost assumed to be the same as for Thomas Electronics in Clyde, NY

2/ Owned by N.A. Philips.

*All impact measures are shown as percents. TC = Treatment cost, Sp = Plant Sales, MCC = Manufacturing conversion cost, NI = Company net income, CAP = Annual plant investment, TCC = Capital investment portion of treatment cost.

Table 5-9A (continued)

Impact Measures: Other CRT Plants
Option 2

Plant	Treatment Cost (Mill. $) Investment	Treatment Cost (Mill. $) Annual	Annual Sales (Mill. $)	Impact Measures (Percent)* TC/Sp	TC/MCC	TC/UP	TC/NI	TCC/CAP
Dumont Electronics, Clifton, NJ	NA	NA	13.5	-	-	-	-	-
B-Scan Inc. Phila., PA	0	0	1.5	0	0	0	0	0
Video Display Corp., Stone Mountain, GA	0	0	2.1	0	0	0	0	0
Westinghouse Horsehead, NY	.0790	.0637	72	.082	.127	.178	.014	3.04
Special Purpose Technologies Van Nuys, CA	0	0	NA	0	0	0	0	0
Tektronix, Beaverton, OR	.0025	.0137	545.5	.003	.004	.005	.017	.013
Tex-Video Man., Houston, TX	0	0	NA	0	0	0	0	0
Total, Option 2	1.4825	.8506	918.4					

Notes: Annual Sales are from EIS data file; 1982 $. NA = Data not available.

1/ Treatment cost assumed to be the same as for Thomas Electronics in Clyde, NY

2/ Owned by N.A. Philips.

*All impact measures are shown as percents. TC = Treatment cost, Sp = Plant Sales, MCC = Manufacturing conversion cost, NI = Company net income, CAP = Annual plant investment, TCC = Capital investment portion of treatment cost.

Table 5-9B

Impact Measures: Other CRT Plants
Option 3

Plant	Treatment Cost (Mill. $) Investment	Treatment Cost (Mill. $) Annual	Annual Sales (Mill. $)	Impact Measures (Percent)* TC/Sp	TC/MCC	TC/UP	TC/NI	TCC/CAP
Raytheon, MA	.8265	.4047	95.0	.426	.658	.930	.125	24.10
Clinton Elec, IL	.3145	.1347	41.2	.327	.505	.714	NA	21.15
Thomas Elec, NY	.2842	.06595	2.4	2.748	4.247	5.999	NA	97.19
Thomas Elec. NJ 1/	.0842	.06595	9.2	.717	1.108	1.564	NA	25.35
Thomas Elec. of Calif. 1/	.0842	.06595	1.7	3.879	5.995	8.471	NA	137.20
Hewlett Packard, CO 1/	.0842	.06595	93.5	.071	.109	.154	.025	2.49
Gen. Atronics. PA 2/	0	0	4.5	0	0	0	0	0
Litton Ind. CA	NA	NA	36.3	NA	NA	NA	NA	NA
Dumont Electronics, NJ	NA	NA	13.5	NA	NA	NA	NA	NA
B-Scan Inc, PA	0	0	1.5	0	0	0	0	0
Video Display, GA	0	0	2.1	0	0	0	0	0
Westinghouse, NY	.0842	.06595	72.0	.092	.141	.199	.015	3.24
Special Purpose Technologies, CA	0	0	NA	0	0	0	0	0
Tektronix, OR	.0025	.0137	545.5	.003	.004	.005	.017	.013
Tex-Video Man, TX	0	0	NA	0	0	0	0	0
Total, Option 3	1.5645	.88285	918.4					

Notes: Annual Sales are from EIS data file; 1982 $. NA = Data not available.

1/ Treatment cost assumed to be the same as for Thomas Electronics in Clyde, NY

2/ Owned by N.A. Philips.

*All impact measures are shown as percents. TC = Treatment cost, Sp = Plant Sales, MCC = Manufacturing conversion cost, NI = Company net income, CAP = Annual plant investment, TCC = Capital investment portion of treatment cost.

unadjusted profit at the plant level is less than 1.55 percent for Option 2 and less than 1.65 percent for Option 3 for any of the plants.

The cost of treatment to the firm's net income ranges up to 5.22 percent for Option 2 and up to 5.62 percent for Option 3. These values are associated with one plant (the Zenith plant in Melrose Park, Illinois) and if it is excluded, the ratio is less than 1.60 for Option 2 or 3. It should be noted that this Zenith plant is closing and its production will move to Taiwan according to a recent announcement in Electronic News.

The capital investment portion of treatment cost TCC/CAP, is less than 21.00 percent of annual plant investment if the Zenith plant is excluded; if Zenith is included, the ratio is as high as 32.91 percent for Option 3.

II.3.2 Other CRT Plants. Eight existing plants incur treatment costs under Option 2 and incur additional costs for Option 3 as shown in Tables 5-9A and 5-9B; for two other plants (Litton and Dumont) treatment costs have not been estimated.

The ratio of treatment cost to plant sales TC/Sp, ranges up to 3.75 percent for Option 2 and up to 3.88 percent for Option 3. For treatment cost relative to manufacturing conversion cost TC/MCC, the ratio is as high as 5.79 percent for Option 2 and 6.00 percent for Option 3. For treatment cost to unadjusted plant level profit TC/UP the ratio is as high as 8.18 percent for Option 2 and 8.47 percent for Option 3.

For all three of the impact ratios discussed above, the high values are associated with one plant owned by Thomas Electronics of California. The plants showing the second and third highest impact in terms of these three impact measures are owned by same parent company; the second highest set of impact ratios is for the Clyde, New York plant and the third highest are for the Wayne, New Jersey plant.

To consider the total treatment cost burden to the Thomas Electronics Company, aggregate costs were compared to aggregate sales for the three plants. Also, aggregate costs for the three plants were compared to total company sales. The ratio of aggregate treatment costs to aggregate plant sales is 1.437 percent for Option 2 and 1.488 percent for Option 3. At the firm level, total sales are estimated to be "over $400 million" (according to Standard and Poors Directory of Corporations). Using $400 million as total company sales, the aggregate treatment costs of the three plants is less than 0.05 percent of firm sales. Because Thomas Electronics is privately owned and not required to publish financial data, estimates of treatment costs to net income cannot be carried out.

The ratio of plant treatment cost to the firm's net income is less than 0.14 percent for any of the publicly owned plants for either Option 2 or 3. However, it should be noted that net income data are fragmentary for this industry subcategory. The ratio of capital investment for treatment to annual plant investment is less than 25 percent for any of the plants, except those

owned by Thomas Electronics; for the most severely impacted plant of Thomas Electronics of California, the ratio is 129 percent for Option 2 and 137 percent for Option 3.

Returning to the first mentioned impact measure of treatment costs to sales, this ratio has been used in other EPA impact studies to identify plants that potentially might experience severe impacts. If a value of this ratio equal to, or greater than, one percent is used as a screening criterion, two plants are severely impacted under Option 2 or Option 3; both are owned by Thomas Electronics. If a value equal to, or greater than, two percent is used, the same two plants are noted as potentially severely impacted. With three percent as a screening criterion, only one plant (Thomas Electronics of California) is severely impacted. With a criterion of four percent, no plants are severely impacted under either Option 2 or Option 3.

II.3.3 Luminescent Coatings Plants. Four of the five existing plants would incur treatment costs under Option 2 as shown in Table 5-10. The U.S. Radium, Morriston, N.J. plant has no discharge and therefore has no treatment costs. (Option 3 does not apply to this subcategory.)

All the impacts based on annual treatment costs are relatively small. None of the impact measures based on annual costs exceed 0.18 percent. The highest ratio of the capital investment impact measure is less than 1.70 percent.

III. Possible Plant Closures

III.1 Color TV Picture Tube Plants

The first mentioned impact measure indicates treatment costs to plant sales will be less than 0.6 percent for color TV picture tube plants. A plant may have multiple product lines with dedicated treatment facilities for one or more particular product line. If so, the treatment costs should be allocated to the selected product line (or lines) which incur the additional treatment costs. In such cases, the ratio of treatment cost to product line sales could be higher than the values estimated in the above impact analysis; if higher than the ratios calculated for the plant, a product line shutdown may be implied. However, sales data on a product line basis are not available.

Two other impact measures--treatment cost to manufacturing conversion cost and to unadjusted plant profit--support the above conclusion that impacts are slight because the ratios are less than two percent (Option 2 or Option 3) for any of the plants.

The next impact measure of treatment cost to firm net income is as high as 5.63 percent for one plant (Zenith, Melrose IL). However this plant is closing as noted earlier, for reasons other than treatment cost impacts.

Table 5-10

Impact Estimates: Luminescent Coatings
Option 2

Plant	Treatment Cost (Mill. $) Invest-ment	Treatment Cost (Mill. $) Annual	Annual Sales (Mill. $)	Impact Measures (Percent)* TC Sp	TC MCC	TC UP	TC NI	TCC CAP
RCA, Lancaster, PA	.0025	.0137	117.2	.012	.019	.041	.025	.039
GTE, Towanda, PA	.0025	.0137	216.7	.006	.010	.022	.017	.021
GE, Cleveland, OH	.0025	.0137	13.1	.105	.166	.370	.001	.353
U.S. Radium, Morristown, NJ	0	0	3.6	0	0	0	0	0
Westinghouse, Bloomfield, NJ	.0959	.0712	104.6	.068	.108	.178	.0162	1.695
Total, Option 2	.1034	.1123	455.2					

Notes: Annual Sales are from EIS data file; except one plant where sales are derived from employment; 1982 $.

*All the impact measures are shown as percents. TC = Treatment cost, Sp = Plant Sales, MCC = Manufacturing conversion cost, NI = Company net income, CAP = Annual plant investment, TCC = Capital investment portion of treatment cost.

Some of the larger firms engaged in TV picture tube manufacturing show relatively low net incomes, for example, Zenith with $15 million in 1981. However, Zenith and the other firms manufacture complete color TV sets and therefore it does not seem reasonable to consider a possible TV tube plant or product line shutdown without considering the plant's relationship as a supplier to one of the firms' major product lines. A modest cost increase in the picture tube can probably be passed through to the downstream TV set manufacturer in the same firm. Also, firms such as RCA are large and highly diversified (for example, broadcasting, major appliances, and defense hardware) and capital investment for treatment at the plant level is not exorbitant compared to annual investments routinely contemplated by large, diversified firms. (The Zenith plant has the highest ratio but capital investment for Option 3 is less than 35 percent of the annual investments at the plant level).

Based on the observations discussed above, no closures are anticipated among the color TV picture tube manufacturing plants for any treatment option.

III.2 Other CRT Plants

The three plants owned by Thomas Electronics show the highest impacts as pointed out earlier. In particular, treatment costs for the Los Angeles plant are less than four percent of sales under either Option 2 or 3 and the capital investment component of treatment cost is 129 to 137 percent of the average annual plant investment for the two options. This plant is small with annual sales of $1.7 million relative to company sales. The Clyde NY plant is also small (sales of $2.4 million). It is conceivable that Thomas Electronics might consider closing one or both the California and New York plants and consolidate all CRT manufacturing at the Wayne, NJ plant if (1) the Wayne, NJ plant--with CRT sales greater than the aggreagate sales of the other two Thomas CRT plants--has slack capacity and (2) the company's major market opportunities are compatible with expanding their operations on the East Coast. However, the size of the company (over $400 million in annual sales and 400 employees) suggest an adequate financial base to afford the expenditures for wastewater treatment. Therefore, no closures of any CRT plants are expected.

III.3 Luminescent Coatings Plants

None of the coatings plants are closure candidates. As noted earlier, all of the treatment measures are relatively small.

IV. Production and Employment Impacts

If treatment costs are absorbed by manufacturers, prices of plant output are, of course, unchanged. Therefore, there are no production or employment changes due to treatment costs.

If treatment costs are passed through by manufacturers, the price increase of end-products (television sets, instruments containing CRT's and luminescent coated lamps) is small and unlikely to affect demand (and hence production) for two reasons. First, treatment costs relative to value of production at the specific plants in any of the three industry subcategories is less than one percent with the exception of the Thomas Electronic plants discussed earlier. Secondly, the percent increase in prices for the end-products is less than the treatment cost impact noted at any of the TV picture tube plants, the other CRT plants or the coatings plants. This is explained by the fact that the output of these plants represent only a fraction of the value of the end-product. For example, assume the price of a component accounts for one-third the value of the end-product; a scientific instrument sells for $600 and the CRT represents $200 of that selling price. A five percent increase in the price of the CRT increases the instrument price to $610; thus, the price of the end-product increases only 1.67 percent (i.e., the component price increase of 0.05 multiplied by its proportionate share of the end-product value of 0.333).

The two small CRT plants owned by Thomas Electronics are not expected to close, but assuming that they did, this does not imply an overall loss of production. If Thomas closed one or both plants, that decision might well be based on increasing production at their largest plant in Wayne, NJ. Or, other firms would increase their production if Thomas Electronics did not opt to maintain their share of total industry CRT output. Thus, while the geographical distribution of production might shift if Thomas Electronics closed one (or two) of its plants, on an industry-wide basis, no reductions in total output are anticipated as a result of any of the options.

Employment levels in each of the three industry subcategories are not likely to change due to the costs of treatment Option 2 or 3. This conclusion derives from the conclusion about production impacts because a constant ratio of plant employment to production is assumed.

V. Foreign Trade Impacts

The costs for any of the treatment options are not likely to result in impacts on foreign trade or decisions by U.S. firms to relocate plants outside the U.S. The treatment cost effects on prices (if passed through) are small on an industry-wide basis for any one of the three industry segments. This conclusion applies, even though the treatment cost-to-sales ratios are relatively high for the Thomas Electronic plants discussed earlier. Because these plants are small, any price increases that might be implemented by that company is not likely to affect U.S. industry's position in imports or exports of CRT's.

The decision of some U.S. firms to relocate their production in foreign countries and the decision of some foreign owned firms to open manufacturing plants in the U.S. are based on much more fundamental reasons than can be associated with the relatively small effects of treatment costs. These rea-

sons include labor cost differentials and overall cost of operations, corporate strategy for increasing market share and existence (or threat) of import quotas and/or other measures undertaken at the national level.

VI. New Sources

The additional costs that a new source might incur if higher treatment requirements are imposed, compared to existing sources, could pose a barrier to new firms entering the industry or to existing firms who may otherwise build new plants. Whether or not there will be sufficient demand to attract new plant investment is not addressed. That issue depends in large degree on current industry capacity and the intensity with which it is utilized. No information is available on plant capacity and current utilization. Therefore, the analysis concentrates on the first issue concerning potential barriers to entry into the three industry subcategories.

VI.1 Treatment Costs for New CRT Plants

Color TV picture tubes and other CRT's are analyzed as one subcategory and the treatment costs relative to raw waste load are shown in Section 4. Two cases for new CRT plants are considered. Case A analyzes the impact of the incremental treatment cost between Option 2 and Option 3 because existing indirect dischargers will be required to attain a level of treatment equivalent to PSES-2.

Case B analyzes the impact of the total treatment cost for Option 3 because no regulation is being proposed for existing direct dischargers. Therefore, a new direct discharger may incur the total cost between no treatment (i.e., raw waste load) and a level of treatment equivalent to BAT-3. For both cases, three plant sizes have been selected covering the range from small (with 10,000 gpd wastewater flow) to large (500,000 gpd).

VI.1.1 Case A

For this case, the incremental cost between Option 3 and Option 2 for the three plant sizes is shown in Table 5-11; the capital costs range from $7,700 to $167,500 and the annual costs, from $15,800 to $82,200. The relationship between quantity of tubes produced and wastewater flow for existing color TV picture tube plants ranges from 10 to 30 tubes per thousand gpd with an average of 20; these values are applied to both TV picture tube and other CRT new model plants.

The annual production of CRT tubes for the three model plants is shown in Table 5-12 for the low, average and high values of 10, 20, and 30 tubes per thousand gallons per day. The annual treatment cost (shown in Table 5-11) is then applied to the annual tube production figures in Table 5-12 to obtain the cost per CRT. The costs shown in Table 5-12 range from $0.02 to $0.63

Table 5-11. Case A
Additional Treatment Cost for New Sources (1982 $)
(CRT Plants)

	Plant Size (gpd)		
	10,000	100,000	500,000
Capital Investment ($000)	7.7	45.8	167.5
Annual Cost ($000)	15.8	31.6	82.2

Table 5-12. Case A
Impact of Treatment Cost on Cost per Tube (1982 $)
(New CRT Plants)

Plant Size (gpd)	CRTs Produced per 1000 gpd	Annual Plant Production of CRTs (000)	Annual Treatment Cost ($000)	Cost per Tube ($)
10,000	10	25	15.8	0.63
	20	50	15.8	0.32
	30	75	15.8	0.21
100,000	10	250	31.6	0.13
	20	500	31.6	0.06
	30	750	31.6	0.04
500,000	10	1,250	82.2	0.07
	20	2,500	82.2	0.03
	30	3,750	82.2	0.02

Note: Annual production is based on 250 days per year of plant operation.

per tube. If these incremental costs are passed through to buyers, the price increases range from 0.02 percent to 0.69 percent for color TV picture tubes, and from 0.01 percent to 0.24 percent for other CRTs; these percentages are based on the unit values shown earlier in Table 5-4 for color TV picture tubes and in Table 5-5 for other CRTs.

The price increases attributed to Option 3 treatment costs for new sources are very small and not likely to be a competitive disadvantage even if all the cost is passed through. Also a new plant would take advantage of more up-to-date, efficient production processes than used in existing plants; thus overall costs of manufacturing--including the additional cost for Option 3--are likely to result in a lower cost per CRT than can be met in existing plants.

The capital investment costs for Option 3 are modest (assuming that even a small plant will require capital expenditures of at least one million dollars) and the price increases that might stem from Option 3 are very small. Thus, in our judgment there are no significant barriers to new sources entering the CRT industry that are attributable to treatment costs.

VI.1.2 Case B. The total cost for CRT plants to achieve new source standards equivalent to Option 3 are shown in Table 5-13 and range from $113.1 thousand to $1,734.5 thousand for capital investment and the annual costs range from $77.6 to $950.2 thousand. Table 5-14 shows the impacts of treatment costs. The cost per CRT range from $3.10 for a small plant (10,000 gpd) with a low output (i.e., CRT's produced per 1,000 gpd) to $0.24 for a large plant (500,000 gpd) with high output (i.e., 30 CRT's produced per 1,000 gpd).

Table 5-13. Case B*
Treatment Cost for New Sources (1982$)
(CRT Plants)

	Plant Size (gpd)		
	10,000	100,000	500,000
Capital Investment ($000)	131.1	736.30	1,734.5
Annual Cost ($000)	77.6	410.0	905.2

Table 5-14. Case B
Impact of Treatment Cost on Cost per Tube (1982 $)
(New CRT Plants)

Plant Size (gpd)	CRT's Produced per 1,000 gpd	Annual Plant Production of CRT's ($000)	Annual Treatment Cost ($000)	Cost per tube ($)
10,000	10	25	77.6	3.10
	20	50	77.6	1.55
	30	75	77.6	1.03
100,000	10	250	410.0	1.64
	20	500	410.0	0.82
	30	750	410.0	0.55
500,000	10	1,250	905.2	0.72
	20	2,500	905.2	0.36
	30	3,750	905.2	0.24

* Treatment cost is total for Option 3 (i.e., not the increment between Option 3 and Option 2).

Using existing plants as a guide, the small plants are likely to be associated exclusively with CRT's other than TV picture tubes and the value of production for these tubes in the baseline estimate is $264.30. The $3.10 cost per tube is about 1.2 percent of the unit value which is the maximum impact on this industry segment of other CRT's. Using an average output (20 CRT's per 1,000 gpd) the small plants would experience an impact of $1.55 per tube which is 0.6 percent of the unit value.

Plant size of color TV picture tube plants are likely to be over 100,000 gpd based on existing plants (none of which are smaller than 200,000 gpd). The value of these tubes is $91.18 in the baseline estimate. Based on the 100,000 gpd plant size, the treatment cost per tube ranges from $1.65 to $0.55 per tube or from 1.8 percent to 0.16 percent of the unit value.

For either of the above industry segments--color TV tubes and other CRT's--the ratio of cost to sales value is less than two percent. The value of production per tube includes plant profits and therefore, the ratio of treatment cost to production cost would be higher than two percent.

Even so, the higher treatment cost per tube for CRT's other than color TV tubes are associated with higher value product (i.e., $264.30 versus $91.18) for color TV picture tubes. Therefore, the impact (cost-to-value) is not as severe as may be inferred from the $3.10 cost per tube when the CRT's are analyzed as two industry segments rather than as a single segment.

VI.2 New Luminescent Coatings Plants

Three plant sizes were selected covering the range from small (10,000 gpd) to large (250,000 gpd). We assume that new plants will be required to achieve NSPS and PSNS wastewater treatment levels equivalent to BAT-2 and PSES-2 and that existing plants will not be required to attain any higher level of treatment over current, in place, treatment. Therefore the additional treatment cost burden for new sources relative to existing plants is the total treatment cost of Option 2. The costs are shown in Table 5-15 for the three plant sizes; capital investment ranges from $91,100 to $1,163,200, and annual costs from $68,200 to $589,600. In contrast to the new source CRT analysis (where there is some information available on plant production quantities and wastewater flow), there is no information on plant production quantities for luminescent coatings plants to obtain a relationship between flow and output quantities. Based on two of the five existing plants where total plant output appears to be for only one product line--luminescent coatings--plant sales range from $260 to $1,440 in sales per thousand gallons of wastewater flow; the average of the two is $850.

Table 5-15

Additional Treatment Cost for New Sources (1982 $)
(Luminescent Coatings Plants)

	Plant Size (gpd)		
	10,000	100,000	500,000
Capital Investment ($000)	91.10	628.90	1,163.20
Annual Cost ($000)	68.2	328.5	589.6

Using this crude relationship of wastewater flow to sales, treatment cost as a percent of plant sales is calculated and displayed in Table 5-16. For the small model plants (10,000 gpd) the treatment cost is as high as 10.5 percent of plant sales and ranges down to 1.9 percent depending on the value selected for the sales-flow relationship. One existing small plant (U.S. Radium in Morristown, NJ) suggests that a new small plant in the 10,000 gpd range would experience an impact of treatment cost to sales of 1.5 to 2.0 percent. (The existing plant with sales of $3.6 million according to the EIS data file, and 10,000 gpd establishes the high end of the sales to flow relationship of $1,440 sales per 1,000 gallons.) This magnitude of treatment cost impact is small enough so that manufacturing improvements incorporated in a new plant design might well remove the apparent cost disadvantage calculated above (however the degree to which the existing U.S. Radium plant utilizes up-to-date process technology and plant design is not known).

Considering all the plant sizes, Table 5-16 shows a cost to sales ratio ranging from 10.5 percent to 0.7 percent; therefore if the additional treatment costs were passed through, prices for output of new plants might be higher by 0.7 to 10.5 percent than output from existing plants.

Table 5-16

Impact of Treatment Cost on Cost to Sales (1982 $)
(New Luminescent Coatings Plants)

Plant Size (gpd)	Sales per 1000 gal of flow ($)	Annual Plant Sales ($000)	Annual Treatment Cost ($000)	Annual Treatment Cost to Sales (%)
10,000	260	650	68.2	10.5
	850	2,125	68.2	3.2
	1,440	3,600	68.2	1.9
100,000	260	6,500	328.5	5.1
	850	21,250	328.5	1.5
	1,440	36,000	328.5	0.9
500,000	260	16,250	589.6	3.6
	850	53,125	589.6	1.1
	1,440	90,000	589.6	0.7

Note: Annual sales is based on 250 days per year of plant operation.

The simplified analysis described above does not consider the relationship of coatings plant to downstream users of the product. At least four of the existing five plants are owned by large firms (RCA, GE, Westinghouse, GTE) that utilize the coatings in their CRT and lamp production; the amount of the new coatings production used captively is unknown. It seems reasonable that if new plants were built by one of these firms, or another large corporation, the plants would be large (e.g., 100,000 gpd) and vertically integrated with other plants owned by the firm. Thus treatment costs would be in the range of 0.5 to 2.0 percent of the value of coatings output.

The tentative conclusion is that large integrated firms seeking new sources of luminescent coatings will not face a cost burden from treatment costs sufficient to dissuade them from building new plants. For new, small coatings plants that are not vertically integrated with CRT or lamp manufacturing, treatment costs may possibly pose a barrier to entering the industry.

VI.3 Comparison of New Luminescent Coatings and New CRT Plants

With regard to capital investment, the additional treatment cost for a new coatings plant may be as high as 15 times as costly as a new CRT plant of comparable flow if treatment costs for the CRT are based on Case A. (For example, at 10,000 gpd the coatings plant investment is $91.10 thousand and for the CRT plant it is $7.7 thousand, or a ratio of 12 to 1; for the 100,000 gpd plant the ration is 14 to 1.)

If new coatings plants are compared to new CRT plants based on Case B, the difference in capital costs for treatment are relatively small. In this case, a CRT plant shows a capital cost that is about 20 percent higher than a coatings plants of comparable size.

With regard to capital investment, the additional treatment cost for a new coatings plant may be as high as 15 times as costly as a new CRT plant of comparable flow. (For example, at 10,000 gpd the coatings plant investment is $91.10 thousand and for the CRT plant it is $7.7 thousand, or a ratio of 12 to 1; for the 100,000 gpd plant the ratio is 14 to 1.) If we also make a comparison of value of plant output, the small 10,000 gpd coatings plant has annual sales of $3.6 million (based on the U.S. Radium plant) while a new CRT plant of the same size has sales of perhaps $10 to $20 million. Thus the capital cost is substantially higher relative to its sales potential for the new, small coatings plant than for the new CRT plant. It should be noted that the additional cost of luminescent coatings plant is the total treatment cost to achieve BAT-2 or PSES-2 because no regulation is being prepared for existing plants. For the new CRT plants, the additional treatment cost is the increment between Option 2 and Option 3 because existing plants will attain BAT-2 or PSES-2.

VII. Small Business Analysis

Under the Regulatory Flexibility Act of 1980, the EPA and other regulatory agencies are required to consider the effects of proposed regulations on small companies. This section reviews the potential small business impacts of the Proposed Regulations for the color TV picture tubes, other CRT's and luminescent coatings industries.

The Act relies on the Small Business Administration (SBA) for guidance in defining a small firm. The Small Business Act, section three, defines a small business as:

> "...a small business concern shall be deemed to be one which is independently owned and operated and which is not dominant in its field or operation. In addition to the foregoing criteria, the Administration (of the SBA), in making a detailed definition may use these criteria, among others: Number of employees and dollar volume of business."

In addition, the SBA published specific employee based guidelines for various business activities including manufacturing. The SBA defined a small firm as one with not more than 750 employees. Companies classified in SICs 2831 and 2833 with not more than 250 employees are considered small; this is the criterion used in this analysis. It should be noted that even 250 employees may be large, given that the Regulatory Flexibility Act is concerned with firms with limited resources and is aimed at avoiding regulatory barriers to entry into an industry.

This analysis is conducted to determine whether small firms bear disproportionate impacts under the proposed effluent guidelines. The firms in the study are described in terms of their sales and employment. The distribution of treatment costs incurred by plants belonging to the firms is analyzed.

Six firms from the study sample of eighteen (one-third of the total) may be candidates for the small business category based on employment of 250 or less shown in Table 5-17. (This determination cannot be made with certainty because firm-level sales and employment figures are lacking for five of the smallest companies.)

The twelve largest firms incur 100 percent of the Option 2 treatment costs of $2,869,200. The same is true for Option 3; the twelve largest firms incur all of the $3,055,800 treatment costs. All of these firms have more than 250 employees.

Thomas Electronics (ranked eleventh, based on sales in Table 5-17) is too large to qualify as a small business but is of concern because it is impacted by treatment costs to a greater degree than other firms in this study. The three Thomas Electronics plants incur 6.62 to 6.47 percent of total treatment cost under Options 2 and 3, respectively.

Clinton Electronics (ranked twelfth in sales) incurs costs of $129.7 thousand for Option 2 and $134.7 thousand for Option 3 representing 4.50 and 4.41 percent of the total costs for those options. The total firm sales and employment are not reported for this privately owned firm.

U.S. Radium (ranked fourteenth in sales) is a small publicly held firm with sales of $12 million and employment of 190 in 1981. As Table 5-17 shows, U.S. Radium does not incur costs. Except for Dumont, all other small firms incur no treatment costs; treatment costs for Dumont are not available.

Table 5-17

Firm Ranking by 1981 Sales

1981 Sales Rank	Firm	Millions $	Employment	Annual Treatment Cost** ($000)			
				Option 2		Option 3	
1	General Electric	27,240.0	-404,000	68.2	(2)	88.8	(1)
2	Westinghouse	9,367.5	147,841	134.9	(2)	95.9	(1)
3	RCA	8,004.8	119,000	864.1	(3)	973.4	(2)
4	Raytheon	5,636.2	79,500	388.7	(1)	404.7	(1)
5	Litton	4,942.8	76,500	NA	(1)	NA	(1)
6	Sony	3,864.1	38,550	13.7	(1)	52.1	(1)
7	Hewlett Packard	3,578.0	64,000	63.7	(1)	66.0	(1)
8	N.A. Philips	3,030.0	49,400	188.3	(4)	181.6	(2)
9	Zenith	1,275.2	28,000	813.7	(1)	877.2	(1)
10	Tektronix	1,061.8	24,028	13.7	(1)	13.7	(0)
11	Thomas Electronics	400.0	400	191.1	(3)	197.8	(3)
12	*Clinton Electronics	41.2	700	129.7	(1)	134.7	(1)
13	*Dumont Electronics	13.5	230	NA	(1)	NA	(1)
14	U.S. Radium	12.0	190	07	(1)	0	(0)
15	*Video Display Corp.	2.1	36	0	(1)	0	(1)
16	*B-Scan Inc.	1.5	25	0	(1)	0	(1)
17	Special Purpose Tech.	NA	NA	0	(1)	0	(1)
18	Tex-Video Man.	NA	NA	0	(1)	0	(1)
				2869.8	(27)	3055.9	(22)

*Plant Sales and Employment are used as if they are firm-level data.

**Number of plants included in the study are shown in parentheses. Fewer plants a counted under Option 3 than Option 2 because Option 3 does not apply to lumninescent coatings plants.

Section 6

Limits of the Analysis

The results of the impact analysis depend on several major assumptions underlying the methodology and on the accuracy of data used to carry out the impact calculations. The assumptions and data limitations are discussed in this section with two main purposes in mind. First, the reader should be aware of the major uncertainties in using the results of the economic impact analysis. Secondly, the discussion of major uncertainties may elicit the discovery of more appropriate data or methodology which then might be incorporated in judgements and decisions that eventually must be made in the process of promulgating new regulations.

I. Plants With Multiple Product Lines

There is a lack of information on product lines for individual plants, particularly the sales value of product lines affected by additional wastewater treatment. This data deficiency has resulted in the allocation of treatment cost to total plant sales and therefore may underestimate impacts on the specific product lines of color TV tubes, other CRTs, and luminescent coatings which are the subjects of this study. For example, the Tektronix Company makes various kinds of scientific instruments and many of these incorporate cathode ray tubes which the firm produces for captive consumption. If additional wastewater treatment is needed just for the CRT production line, the impact of treatment costs estimated are low because the costs are measured against total plant sales of the Beaverton, Oregon plant as reported in the EIS data file. This problem of potential underestimation of impacts seems particularly important for the CRT plants with relatively large sales (such as Tektronix, Raytheon, and Hewlett Packard) because we suspect that the CRT is only one of the product lines. Also, three color TV picture tube plants and two luminescent coatings plants may each have several major product lines; this judgement is based on the wastewater flow associated with the products addressed in this study compared to the flow reported for the entire plant.

II. Impact Measure Derivation

To develop plant level impact measures in addition to the treatment cost/sales ratio, we have estimated manufacturing conversion costs, unadjusted profit and annual plant investment. The derivations rest on aggregate rather than plant-specific information and use data that are not up-to-date. The aggregate data are at the 4-digit SIC level. Therefore, the method implicitly assumes each plant operates with the average ratio of sales (a) to conversion costs, (b) to profit, and (c) to annual investment as the 4-digit SIC group. In addition, the data used are from the 1977 Census of Manufacturers which may not typify the current relationships for each of the three industry subcategories.

III. Discount Factors

The capital recovery factor used to annualize the investment portion of the treatment cost is based on a 13 percent discount rate and a five-year equipment life. The appropriateness of any particular discount rate is debatable. Therefore, we have examined the sensitivity of plant-level impacts to two alternative rates; 10 percent and 16 percent. Annual costs using these rates were calculated for tube manufacturers under Option 3. (There are five existing color TV picture tube plants and five other CRT plants that incur capital investment expenditures under this option.)

For color TV picture tubes the 10 percent discount rate reduces the annual treatment cost by five percent or less, and the 16 percent rate increases the annual costs by five percent or less. The highest impact ratio of treatment cost sales was computed to be 0.558 percent. With the alternative discount rates this value becomes 0.530 percent (for the 10 percent rate) and 0.586 percent (for the 16 percent rate). Or, in absolute terms the treatment cost to sales ratio is only altered by 0.028 percentage points.

For other CRT plants, the 10 percent rate reduces annual treatment costs by four percent or less, and at the 16 percent rate, the annual costs increase by five percent or less. The highest ratio of treatment cost to sales using a 13 percent discount rate was computed to be 3.073 percent. With the alternative discount rates, the ratio becomes 2.950 percent and 3.227 percent for 10 and 16 percent, respectively. In absolute terms the ratio changes by no more than 0.15 percentage points.

The changes in the treatment cost to sales ratio for the alternative discount rates are small. None of the conclusions would change if the alternative discount rates had been used in annualizing the investment portion of treatment cost.

IV. Small Companies

Small firms (with only one plant in some cases) are less likely to be able to pass through their additional treatment costs than large firms. Large firms operate color TV picture tube plants, other CRT plants, and coatings plants as part of their vertically integrated business. Small plants are likely to be privately owned and not required to provide 10-K information. Therefore, financial ratios cannot be examined to help determine whether or not the financial condition of small firms makes them more vulnerable to adverse impacts of treatment costs.

V. Import Policies

If the production level of U.S. cathode ray tubes declines, the existing plants may be more adversely affected than anticipated because treatment costs will be spread over a smaller production base. If U.S. production

grows over the next few years as anticipated, estimated impacts should be less severe. There are however, uncertainties. The anti-dumping regulations imposed by the U.S. on Japanese-made TV receivers may or may not continue. Also, other protectionist policies could be adopted that apply to the foreign-made TV picture tubes that are imported and used in TV sets manufactured in the U.S.